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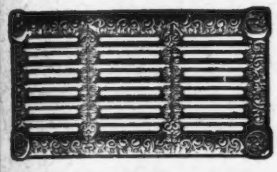

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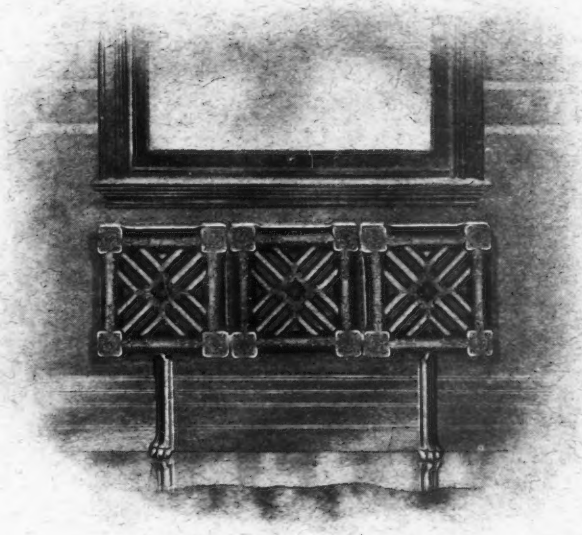

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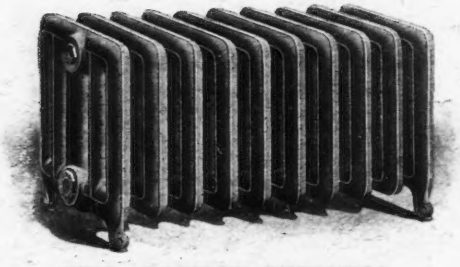

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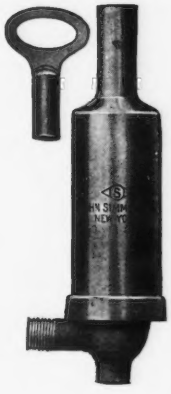

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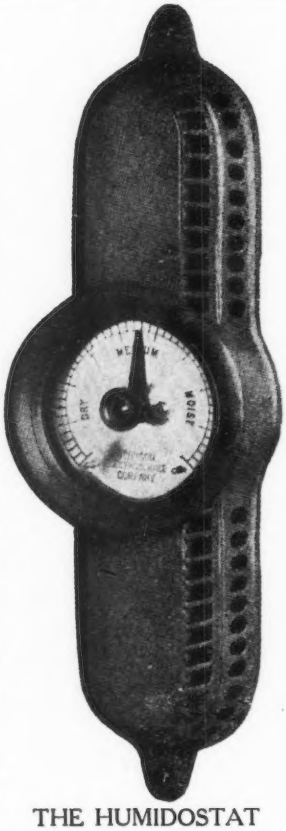

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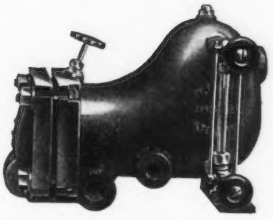

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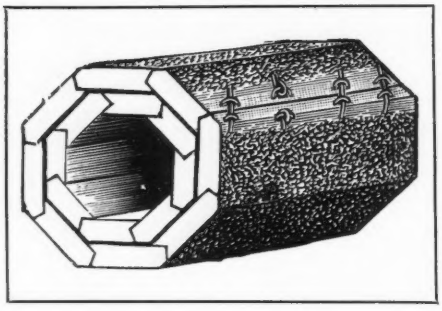

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VOL. V No. 11

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THE HEATING AND VENTILATING MAGAZINE

1123 BROADWAY NEW YORK NOVEMBER, 1908

Single Fan vs. Double Fan Systems of Heating and Ventilation

BY H. L. WILLIAMS

The endless experiments and tests made within the last fifteen years by those who have been connected with the practical rather than the theoretical end of the question of ventilation tend to show that a single fan system of ventilation will not accomplish all that can be done with a double system. In order to make myself thoroughly understood, let me ask what we are trying to get rid of where we employ mechanical means of ventilation? Is it not the old "natural" or "gravity" method? Again, I ask what is it we are trying to get rid of most? Is it not the heavy and foul air in the room to be ventilated?

I think we can all agree that mechanical systems are designed to take the place of the unreliable and variable gravity methods. I think we can also agree that it is the foul air in the rooms that we wish to rid ourselves of when we adopt methods of ventilation. If I am correct in assuming that we can agree on these two points, then we are down to a basis where we can discuss reasonable means of accomplishing the best results. We will agree most cheerfully that it is all important that we furnish plenty of fresh air to the occupants in any room that we wish to ventilate. You cannot take water out of a barrel unless you first put water into it; neither can you take air out of a room unless you provide for a proper air intake. In the old gravity methods the air was taken into the building by what may be well termed "coaxing" methods—that is, the presence in the basement of a heat chamber produced a tendency to a vacuum, which caused the air to flow from the outside towards that vacuum and, being heated, to rise through flues into the room or rooms to be heated and ventilated. The flow was assisted by taking advantage of the air currents themselves. Naturally, such a system depended almost wholly upon atmospheric conditions, and was equally uncertain and variable. To make sure of this flow being the same at all times the "supply blower" is now used with admirable results. There is no question that such a system wholly overcomes the variable and uncertain flow of gravity means.

The funny part to me is that it is seriously contended that what is good for supplying constantly the requisite quantity of pure air is wholly unnecessary for the exhaust of the foul air—the very thing you want to get rid of most in any system of ventilation. Such a contention, I know, is mostly based on the supposition that the pressure exerted to force the air into the room will force it out. On that question I wish to quote from the report of the late Chief Wade, of the Massachusetts District Police, to show what has been demonstrated in actual practice:

"The forcing of abundant fresh air into a room will drive the air out

mainly at the easiest outlets, and some of the most essential may be neglected because of being the easiest way for the air to pass. The only sure way to get the air out just where you want it to go out is to apply an exhausting force at the outlets to guide and assist the expelling force."

If ever a main uttered a truth that was upheld by the best practice, Chief Wade uttered it in the above statement. His position is simply unassailable. It is, however, equally true that the air forced into a room will, with the exception of what compresses, go out. The all important question is, where does it go out? As a ventilating engineer, I am not concerned about what takes place above the "breathing level" of the room I wish to ventilate. I want to know what is going on where the occupants have to do their breathing. The pure air that escapes above their heads does nobody any good, for it does not keep clear the atmosphere in the room where the occupant does his breathing, and what escapes is dead loss from a heating standpoint.

LEAKAGE OF AIR ABOVE BREATHING LINE

The basic law that underlies all good heating and ventilation is that of good distribution. Anything that interferes with the distribution of the fresh warm-air thrown into a room interferes at the same time with both efficient heating and ventilation. The man who would clear the muddy bottom of a watering trough when it is full of water by pouring fresh water on top, would hardly rise up as an expert along that line. The same thing can be truthfully said of the ventilating engineer whose chief concern seems to be to force fresh air in at the top of the room without regard to the leakage that takes place above the heads of the occupants, and evidently without much concern as to what effect it has on the "muddy bottom."

The theory that "if air is forced into a room, it must go out" would probably be sustained if the room which it is sought to ventilate were practically air tight. The pressure of the released air in the room would then continue to accumulate until the pressure at the outgoing register would nearly equal that at the inflow register; but buildings are not now and never have been constructed that way. We are compelled, therefore, to deal with them as they are, and not as we would have them theoretically. We must consider them as leaky and treat them as such. We all know that the laws of air and water are very much alike. Suppose that we assume that we have a room that is water tight. Suppose we introduce at or near the ceilling a supply pipe 6 in. in diameter, while at the bottom of the room we will have an outlet of the same diameter as the inlet, the inlet and outlet pressure being the same. Anyone would at once say that there would be just as much water flow out of the room as came in.

But suppose we now proceed to puncture many holes in the walls of that room so that it will leak all over. Would anyone say that you got the same amount of water out of the room through the regularly provided outlet as came in through the inlet? Certainly not, and the same principle holds good with air, with this additional significance: that what leaks out disturbs the intended distribution and affects the ventilation accordingly.

DIFFICULTIES IN ONE FAN SYSTEM

I now return to the basis that, in a single fan system, you rely wholly on discharging the foul air from a room upon the pressure of the initial or supply blower, plus the natural draft of the vent stack. I take the position that the air once released into the room at a warm air register can never accumulate its pressure in the ordinary building, so it will be the same at the outlet as at the inlet. That being so, and test after test in practice has proven it so, the flow outward by the initial

fan pressure will never be anywhere near the same as at the inlet, unless the vent flue is made much larger than the incoming flue. Most ordinary practice, as well as common sense, shows the question to be true beyond a shadow of doubt. The result is that, in order to have the requisite outward flow of the foul air, you must rely very largely on the draft and size of the vent stack. You are, therefore, back to "gravity" methods in handling your ventilation.

Everybody knows who has ever had any experience with a vent stack that its draft depends almost wholly on the conditions of the atmosphere and is, therefore, just as variable. If so, then it follows that the single fan system of ventilation will vary as the draft of the vent stack varies. If your vent stack is large enough to meet the worst conditions of the atmosphere, it will be vastly excessive when the atmosphere is favorable to a good draft; and when it is excessive—that is, where the pressure of the initial fan plus the natural draft of the stack is sufficient to exhaust more air from the room than you bring in through the regular inlet—then you produce the same results practically that are had in a purely vacuum system. In short, such a course is advocating mechanical means for supplying the fresh air and relying to a great extent on the variable and unsatisfactory "gravity" method for exhausting the foul air. Such a position is hardly reasonable, neither is it consistent.

In discussing single fan systems thus far I have assumed that the vent stack was run through the roof to the outer air, so as to take advantage of the natural draft such a stack would have. I dismiss all single fan systems that open up into the attic and then through the roof by windows as being out of the question when science governs ventilating engineering. It all reminds me of how utterly ridiculous a man would be to build a magnificent, high smoke stack so as to get proper draft for his boilers and then put a roof over it. The only difference there is between the two is that the smoke stack would still have the advantage because it was constantly heated by the smoke from the boiler, while the vent stack would not be so heated.

OPERATING ENGINEER AN IMPORTANT FACTOR

Taking into consideration all the arguments before advanced and the reasonable certainty of the variable results of any single fan system that has yet been designed, I am forced to the conclusion that the success of such a system depends largely upon the eternal watchfulness of the engineer in charge; for the only way that the variable drafts of a vent stack can be controlled is by dampers in the stacks themselves, so arranged that the flow outward may be regulated when excessive. If it is possible to find an engineer who will take enough interest in his work to go around each day of the school year to regulate the dampers in the vent stacks connected with each room, I would like to contribute towards erecting a suitable monument to him while he is yet alive. Our experience teaches us that the more nearly "fool proof" you can make a heating and ventilating system, the better will be the results. For this reason alone I cannot conceive how we could have a more perfect system than to have a bridle on the supply and a bridle on the exhaust, so that the operation of the system at all times would be the same, and depend on no such variable results as must be the case where vent stacks are used in connection with the plenum or force fan. Neither can I understand how anyone can even think it possible that a single fan system will accomplish "all that can be done by a double system." Reason is against it, practice is against it and common sense is against it.

As to a position that "it is more economical to operate, since one fan only has to be looked after, as against two in the other case," I

would say that that hardly needs much consideration. While it is true that, so far as power is concerned, it is a trifle more expensive to operate two fans than one, I doubt whether it is true so far as the entire system is concerned. I am now gathering statistics on that very subject. What I have would indicate that what you save in power you lose in fuel for heating, and that the saving as a whole is in favor of a double fan system. I will, a little later on, be able to determine positively which is in reality the less expensive to maintain. At present, it is as yet an open question with us.

VACUUM VENTILATING SYSTEMS

In discussing the merits of a plenum or vacuum system of ventilating, a vacuum system alone will no doubt remove the foul air all right, but it is a question whether it will bring enough fresh air into the building through the proper channels. In short, a purely vacuum system is rather a bad heating proposition, though I cannot see why it is not effective in removing the foul air.

However, there are some reasons assigned that might lead one to think that arguments such as those I refer to are intended to mean a vacuum fan in connection with the plenum. If so, the argument that "with a suction fan system the opening of a window will almost ruin the ventilation," etc., is wholly at fault. A properly-installed double fan system will do nothing of the kind. Many a time I have demonstrated that, unless there is considerable wind pressure from without, you can open the windows and doors of a room, set a delicate air meter on a window and the wheel will not move—proving that the system is balanced, and the conditions absolutely normal, just as they should be when a proper heating and ventilating system is installed.

The Effect of Wind on Heating and Ventilation

By H. W. Whitten

Methods of preventing air leakage around windows of buildings in preference to the treatment of such leakage as a necessary evil to be offset by additional radiating surface are at last having their day in court. At two recent meetings of the American Society of Heating and Ventilating Engineers the subject was a prominent feature of the programme, being discussed on both occasions by Mr. H. W. Whitten, whose investigations and the tests have given him a fund of information that has proven most valuable to the society and to the profession generally.

A summary of his investigations to date, together with a further discussion of the subject of window leakage, were presented in an address delivered a few weeks ago before the Engineers' Society of Western Pennsylvania and published in the proceedings of that society. In addition to the original presentation of the subject which first appeared in the columns of The Heating and Ventilating Magazine, (October, 1907) some of the new points brought out by Mr. Whitten are presented herewith:

Heat having been generated and circulated through a building, it is of economic importance to find out what becomes of it, i. e., to trace its dissipation. It is lost in three ways, by passage through foul air flues, chimneys, etc., by direct transmission through walls and windows, and by filtration through walls and air leakage through crevices around windows and doors. The first two losses are easily determined, but to quote the latest book on the subject by Prof. John R. Allen, of Michigan University, "The calculation of loss by filtration and leakage must always involve a large factor of judgment and experience." In other words the engineer must guess at it. This

same unsatisfactory and elusive statement was embodied in a report of a committee at the annual meeting of the American Society of Heating and Ventilating Engineers in New York, January, 1908.

One factor which has been known abroad for some time, but generally

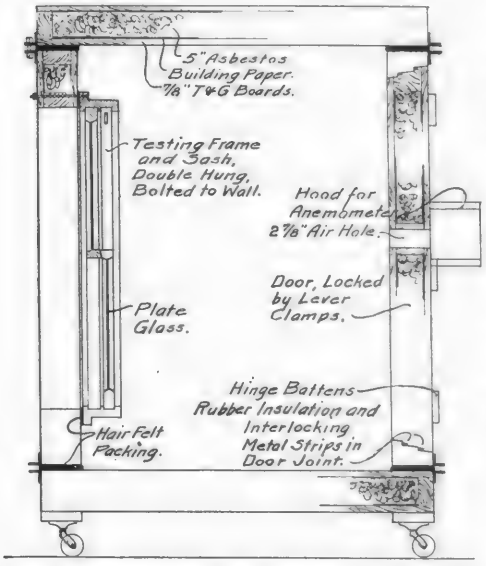
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FIG. 1.—SECTIONAL ELEVATION OF BOX FOR TESTING AIR LEAKAGE AND HEAT LOSSES AROUND WINDOWS

overlooked here, is that all buildings are more or less porous. Probably most of you are familiar with the "brick and candle" experiment, but I have seen two bricks placed end to end, adjourned with mortar, wrapped tightly with impervious material, excepting a space ½ in. in diameter at each exposed end. One space was then covered with soft soap, and by blowing against the opposite end bubbles could be raised in the soap. A very safe statement is that in a well constructed building with all doors and windows tightly closed the air will change about once in an hour.

AIR SEEKS ITS OWN LEVEL

One reason for this is not generally recognized. *Air is constantly seeking its own level.* As it is heated it expands, and at once attempts to rise to a height where it will find air of a similar density, the colder air rushing in underneath to fill the space vacated. It will when heated follow the line of least resistance in order to finally rise. It thus seeks out any porosity in the building, and escapes through it.

Leakage by means of crevices about windows and doors is of a more complex nature than the loss through pores by expansion. It is a known fact that on a calm day most of this kind of loss will take place from the upper portion of the windows, being replaced by incoming currents through the lower portions. The incoming air, being of greater density, falls to the floor. For this reason radiators, whenever possible, are placed near or under windows. The incoming air, being warmed from contract with the radiator, circulates about and upward, gradually leaking out again. This

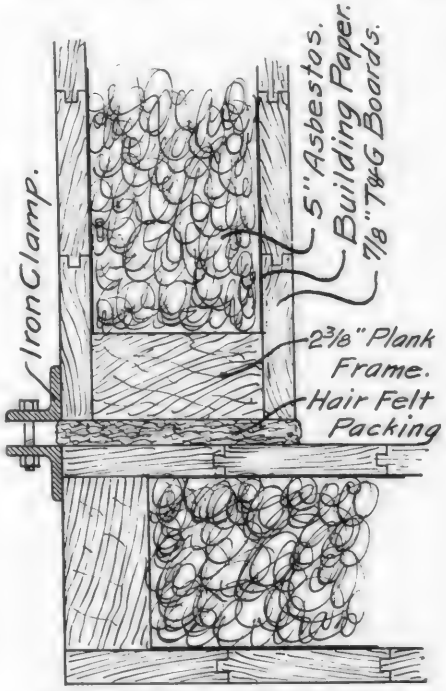

FIG. 2.—DETAIL OF TESTING BOX

would occasion no difficulty if the amount of incoming air remained constant, but this is not the case.

A strong wind blowing against the building will not only greatly increase the amount of air naturally

coming in on that side, but will transform the natural outflow from the upper portion of the windows to a strong inward current.

The warm air must escape somewhere, however, and travels to the leeward side of the building, and out through all the crevices on that side, being assisted by the pressure of incoming cold air, and attracted by the suction of the partial vacuum created by the wind on the sheltered (out) side of the building. The incoming cold air mixing with the air of the room reduces the temperature, as does the escape of the mixed air on the leeward side. This necessitates the supply of a greater number of heat units to maintain the required temperature. It is always found, however, that the temperature is much lower on the windward side than on the leeward. Flue, chimney and roof losses are also greatly increased by wind pressure.

USUAL METHOD OF TREATING AIR LEAKAGE

All these facts have been known to heating engineers for a long time, and provision for leakage losses arrived at by a rule of thumb method acquired by long, painful and costly experience. It has been usual to add to the radiation on the sides of the building exposed to the strongest wind effect an uncertain amount of extra radiation, and to the whole building another uncertain amount. If the guess was successful, the engineer or contractor "made good," if not, he didn't. The whole amount of extra radiation thus used amounted, according to conditions, to from 50% to 100% of the amount actually necessary to heat the building with normal leakage in comparatively still air, which (including the original once an hour before spoken of), amounted to at least two changes per hour. This, in common use, is erroneously called one change per hour. In calculating this extra amount, and, in fact, in any heating calculation, a certain proportion is assigned to wall and another to glass. These unconsciously include leakage, and as most of this is assigned to the glass factor, the rate for glass is thus very high. Little or no attempt had been made to determine the exact value of leakage under varying conditions until I

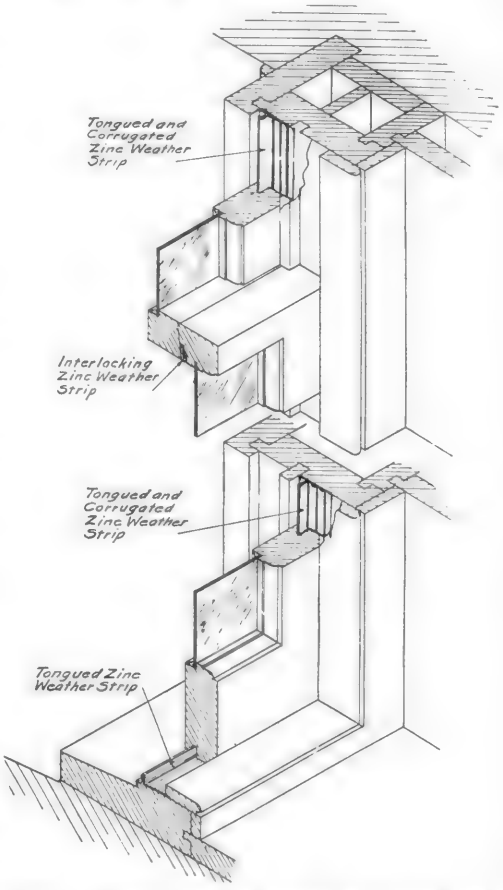
Tongued and Corrugated Zinc Weather Strip
Interlocking Zinc Weather Strip
Tongued and Corrugated Zinc Weather Strip
Tongued Zinc Weather Strip

FIG. 3.—DETAILS OF CONSTRUCTION OF WEATHER-STRIPPED WINDOW SASH WHICH SHOWED BEST RESULTS IN TESTS

took the subject up a few years ago. Finding no data of record here or abroad, I made a series of tests on window frames and sash of varying clearance by subjecting them to fan pressure through an expanded nozzle tightened to the window frame. (See THE HEATING AND VENTILATING MAGAZINE for October, 1907.)

RESULT OF ONE TEST

This test which was observed by several eminent engineers showed conclusively that the leakage factor

was more than 90% of a total exposure loss, the increased loss from glass and wall proper being quite small. It was at once apparent that if efficient means of controlling the effect of the wind in an out leakage through these crevices could be used in the building specifications and construction, and the engineer be aware of the fact, he could dispense with a large portion of the extra radiation heretofore necessary, as well as the "factor of safety" which he usually added to protect himself.

These results when published were stated to be comparative only, but were criticised, the contention being that the air from the fan being confined in a chamber would not have the same effect as air in the open pressing upon a building. In order to trace the actual heat loss and check the fan results a series of tests were conducted on the roof of the West Street Building, New York City, the past winter. A testing house was constructed (Figs. 1 and 2) on the principle of a refrigerator, being insulated with 5 in. thickness of mineral wool, and lined with chemically treated paper. This was placed on castors on a platform 7 ft. above the roof, so that it might be easily turned to face any prevailing wind. An opening was made in one side for a window 2 ft. x 4 ft. in size. The window frame was then bolted on the inside against a felt gasket. The door opposite the window was made to close perfectly tight. In the center of this door was a hole containing 7 sq. in. which had a removable plug, and was protected by a box hood, so that an anemometer placed against it would not be affected by eddying currents. Records of outside wind velocities were kept and various sash tested as also were various wind stopping devices.

RESULTS OF TEST ON HIGH BUILDING

In this paper I shall only give the comparative results of a 1/16 in. clearance and the most effective wind stopping device found, which are as follows

TABLE I—AIR LEAKAGE THROUGH ORDINARY AND WEATHER STRIPPED WINDOWS

Double Hung Window 2 ft. wide x 4 ft. high

Velocity of outside wind in miles per hour	Cu. ft. per min. leakage through space 14 ft. by $\frac{1}{16}$ in. in above window	
	Weather Strip Sash	Ordinary Sash
6	1	12
9.1	1.6	19
9.6	1.75	20
9.5	1.65	19.6

Under 6 miles per hour no perceptible leakage could be detected through weather stripped sash.

The application of this device is shown in Fig. 3, and consists of a sheet of metal (zinc or bronze may be used) covering the runway of the sash and having an extended rib with a beaded edge extending 3/8 in. into a groove in the sash. This also extends across the head and sill. That in the runway is corrugated to reduce friction. The meeting rails are provided with inter-locking male and female members. The comparison obtained shows practically the same leakage and ratio as obtained from the fan. The reason for this is that when the wind blew directly on the sash, the air in the window recess was held in place by the sides of the recess, which prevented lateral motion and formed a cushion on which a continual pressure was maintained by the wind in the rear.

The next step was to determine the heat loss caused by this leakage. in Fig. 4 a view is given of the platform, two sides of the apparatus and the window. Fig. 5 shows the other two sides, door, hood and shelf for testing instruments. An electric radiator was placed inside the testing house, the contents of the latter being about 80 cu. ft. Fig. 6 shows the interior and location of the radiator, which tested out about 796 watts with an average current of 114 volts. A watt-meter, volt-meter and ameter were attached and placed on the shelf shown. These were specal instruments loaned by the Western Electric Co. To the left of the shelf is a common hand switch. The plug in the rear was removed, the current turned on and time noted in which interior temperature raised a given number of degrees. The current was then

shut off and time noted in which the temperature returned to the starting point.

In order to get as great a difference between outside and inside temperatures as practicable, most of the tests were from 70° to 80° and back to 70°. A record of outside temperature and wind velocity was kept carefully. On reaching 70° the switch was thrown on again, and the operation continued for several hours, thus getting a "saw-tooth" curve, which varied at first on account of absorption of heat by the walls. After a time this absorption practically ceased as did the curved variations.

This test was very tedious, covering a long period of time, as it was difficult to get similar conditions on different days. Enough was learned, however, to show that the heat loss caused by leakage was much greater than had ever been supposed. In one case, to quote from my discussion at the semi-annual meeting of the American Society of Heating and Ventilating Engineers, "with outside temperature at 32°, wind 4 miles per hour, with loose sash, it required 38 minutes to raise the interior temperature from 72° to 82°, and 20 minutes for it to return to 72°; with metal stripped sash, wind 4 miles per hour, outside temperature 33°, it required 20 minutes to raise from 72° to 82°, and 39 minutes to return to 72°.

Another table of tests is as follows

TABLE 2

Outside Temperature, 33½° to 34°. Wind Velocity, 3¾ to 4 miles per hour			
Time required to heat 80 cu. ft. 12°		Time required to lose 10° from 80 cu. ft.	
Ordinary Sash	Weather Strip Sash	Ordinary Sash	Weather Strip Sash
38 min.	22 min.	20 min.	37 min.
(Outside temp. 35°; wind, 1½ to 2 miles per hour.)			
26 min.	20 min.	34 min.	43 min.

The last table shows the tremendous ration of increase in heat loss as the wind increases. The writer is engaged in a further and more technical calculation of the tests made last winter, and will make further tests in the far North early in the coming winter. The results will be incorporated in a paper he is preparing for the annual meeting of the American Society of Heating and Ventilating Engineers in January, 1909. The main practical points are given in this paper, at least, enough to enable a competent engineer to take advantage of.

HOW THE INFORMATION GAINED MAY BE APPLIED

Let the engineer calculate his heating lay-out in the usual manner, using any standard method, allowing the usual amount of leakage, ex-

FIG. 4.—VIEW OF TESTING BOX AS SET UP ON ROOF OF WEST STREET BUILDING, NEW YORK

posure, etc., then take the number of lineal feet around the inside of window frame, adding the width of the meeting rail, or what is the same thing, twice the length and three times the width and deduct from his original calculation 35 to 40 heat units for each lineal foot of sash treated as in Fig. 3 He may also dispense with 85% of the radiation added for exposure of glass surfaces. This will usually result in a heating plant 15% to 25% smaller than at first laid out, and the reduc-

tion in annual fuel consumption will show a still greater ratio of saving. As an exemple of what this means, I may say, a year ago Mr. John D. Small, engineer for the D. H. Burnham Co., on account of the fan tests before mentioned, omitted from his plans for the Oliver Building in Pittsburg 10,000 sq. ft. of radiation, which he had originally calculated

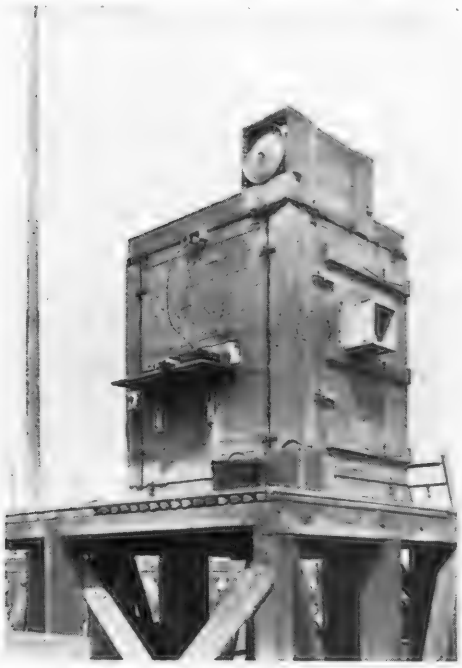

FIG. 5.—ANOTHER VIEW OF TESTING BOX SHOWING OPENING IN DOOR AND ELECTRICAL INSTRUMENTS FOR RECORDING HEAT SUPPLY

for exposure. The sash in the building being treated as in Figs. 3 and 4.

Since the publication of the radiator tests of last winter (there have been a few brave ones previously) very many prominent consulting engineers are insisting that they be allowed to control the window treatment, some even going so far as to provide for this in their own specifications. It will be a matter of surprise to many to know the aggregate opening around a window 3 ft. wide, 6 ft. high with 1/16 in. clearance. The lineal opening is 21 ft. or 252 in. x 1/16 in. equals 15⅛ sq. in.

In inspecting a building in Pittsburg, recently where the windows were very bad, and of large size, with an average clearance of over 3/32 in., I found the aggregate opening for 150 windows to be between 45 and 50 sq. ft. When one stops to consider that the size of the intake for a fan to heat this building would not be over 20 sq. ft. it is easy to imagine the effect that a strong wind would have on the heating plant of such a building. It may be urged that in a building heated by direct radiation, if all the window crevices are practically sealed there would not be sufficient fresh aid admitted for good ventilation. This would probably be true if they were actually sealed so they could not be opened. The condition would be reduced to about the original one change per hour, hardly enough for the health of the occupants. By using the device shown in Fig. 3, any desired quantity of air can be admitted by raising the sash, the device facilitating rather than retarding that operation. A window opened sufficiently to allow a pencil to be placed on the sill will cause a break at the meeting well which will admit a considerable quantity of air. On the other hand, if the weather is cold and the wind high, the windward side of a building can be completely closed at will, if desired.

It will, of course, be understood that where hot water is used as a heating medium, the saving in cost of installation will be greater than in the case of direct steam, as hot water requires about 40% more radiating surface than steam.

TREATMENT FOR INDIRECT RADIATION

Thus far I have considered direct heating plants only, I shall now take up briefly indirect heating. If a hot air furnace is used, it is frequently impossible to heat the windward side of a house. This difficulty is remedied when the windows are properly treated, and, as the air is changed frequently by this method, it is not necessary to open or shut the windows. This would also apply to what is known as gravity indirect

steam where the air is heated by passing over steam pipes in the basement before passing up the flues.

When a fan is used to force the circulation of warmed air through a building, the inlet flues, in the most accepted practice, open in the wall at a point higher than the heads of the occupants and the vent flues near the floor, being placed with relation to each other, so as to insure uniform distribution throughout the room. This distribution is often helped by deflectors placed in the inlets. It is apparent during this circulation that the warmed air, in order to be effective, must be of a desired temperature at the "breathing level" of the room. All warmed air escaping by crevices above this point, or, in fact, by any other means than the regularly provided vents, is absolutely wasted. It can readily be seen that if the upper part of a window be opened in a room heated in this manner, until the space equals the size of the inlet, most of the incoming air from the inlet will pass out of it above the breathing level, if it were a calm day. When the wind blows air will be forced in through all the window crevices on the windward side, and, mixing with the warm air, reduce its temperature above, at and below the breathing line. The movement of air through the vent flue will be accelerated by the extent of the in-leakage.

On the leeward side of the building the partial vacuum on the sheltered (out) side will act as a continual suction on the warmed air, drawing it out above, at and below the breathing line, and the movement of the air through the vent flues retarded to the same extent. All such loss above the breathing line is absolute waste because it has performed no service, but simply "came right in and turned right around and went right out again." That portion at or below the breathing line had also been depleted. In order to attempt to correct this condition as it stands, the fan must be speeded up, spending more horse power. This condenses the steam in the indirect radiators faster, because more air is passed through them. This necessitates a greater activity with the coal shovel or accelerates the gas meter, and in spite of all the condition is not wholly corrected. Ninety per cent. of this waste is needless, and, in these days of scarcity of gas and approaching scarcity of coal, is criminal.

AIR WASHING AND AIR HUMIDIFYING AFFECTED

There is still another important feature of this question to be considered.

Air filters and washers are coming into use very largely, all the air be-

FIG. 6.—INTERIOR OF TESTING BOX SHOWING ELECTRIC RADIATOR AND THERMOSTAT

ing taken in through the fans being strained through cheesecloth screens, washed by films of spray and, after being carefully ironed and dried to the proper degree to humidity by the indirect radiator, is distributed through the building. Numberless types of air washers are on the

market or in preparation. The chief difficulty encountered so far as been the clogging of the spray nozzles, but this will be undoubtly be overcome. In some States and cities air washing and filtering is required by law in the schools, municipal and state hospitals and other types of public buildings. This is a great advance, but it is absurd to distribute this carefully laundried air through a building and immediately mix it with the dust and microbe laden air from the window crevices.

Mr. A. B. Franklin of Boston, one of the pioneers of ventilation, in discussing this question at the annual meeting of the American Society Heating and Ventilating Engineers in January said in part:—

"I had occasion to do work on a school building in Massachusetts, and a test by the State Inspector showed that during high winds from fifty to sixty per cent. more air came out through the vents, than the heating system supplied. During these conditions the children had to be moved away from the windows." I should think it quite likely.

In this case, or even in one where the windows were not nearly as bad, it is evident that the work of the air washer and filter would be undone, and its cost and maintenance wasted.

Fuel economy is imperative in this country, and its waste is criminal. Burned gas and coal cannot be replaced. It is said we can, by wise reforestation, preserve our timber, and in a few generations renew it, but it took more than a few generations to make coal, and we do not know how to make natural gas. I believe I am well within the figure when I say that twenty-five per cent. of all the fuel used in the United States for heating purposes is needlessly wasted. I have recently seen plans of a public institution to be built in this part of Pennsylvania in which the architect, after visiting many similar institutions in various States, in order to find a good method of ventilation, was logically compelled to make all his windows in movable parts of the walls in order that circulation of air might be perfect.

The only movable outer opening in this building is the door. He will have a perfect ventilation, and may wash and iron it with a clear conscience.

It is for the engineers of this country to carry on this work. I may say that the heating engineers have a double reason for doing so; one is because of its economic value, the other is that he is sure of fulfilling his guarantee to the architect or owner, and has not to wait several years for his final payment.

Fan and Heater Arrangements

By Charles L. Hubbard

The exact arrangement of the fan and heater for any given case will, of course, depend upon the form and size of the space which is available for this purpose. The following cuts show different methods of placing these important parts of a ventilating plant, and may be modified to suit various conditions as found in practice.

Fig. 1 shows a very satisfactory arrangement for a schoolhouse or similar building where it is desired to run the plant at low pressure and return all condensation to the boilers by gravity. This makes a desirable arrangement, doing away with all pumps and traps, and reducing the care to a minimum for a plant of this size. If the fan is run by a steam engine, one with a cylinder of large diameter should be chosen, so that the steam pressure required to produce the necessary power will not exceed about 15 lbs. per square inch. Builders of

fans usually carry a line of special low-pressure engines made for this particular purpose.

When the heater room is on the same level as the boiler room it is, of course, necessary to place the heater at an elevation, if the condensation is to be returned by gravity. The bottom of the heater should be at least 2 feet above the water-line in the boilers, if they are near each other, and from 2½ to 3 feet, if they are some distance apart.

For an overhead heater nothing is better than some of the various forms of pin radiators made up in groups of several sections each. Heaters of this type will easily give off 1,600 heat units per square foot of surface per hour under the usual conditions of ventilating work in zero weather. In forms like the "Utica" and 10-in. "School Pin" the spacing of the pins is such that for any given surface based on the above efficiency the velocity of the air through the heater will be well within working limits, so that in designing a heater of this kind it is only necessary to compute the heating surface required. As a matter of precaution, the free air space through the heater may be checked by the figures given in the following table:

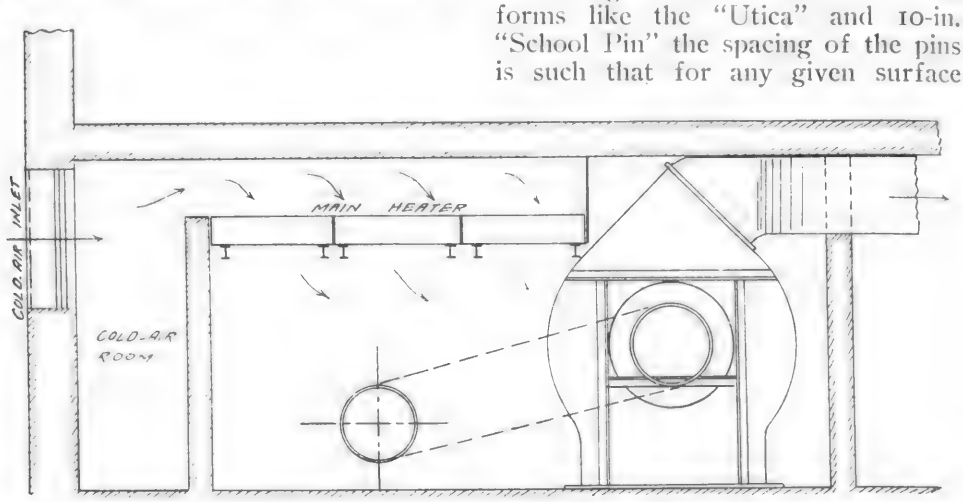

FIG. 1.—ARRANGEMENT FOR SCHOOLHOUSE OR SIMILAR BUILDING, PLANT TO BE RUN AT LOW PRESSURE WITH GRAVITY RETURN

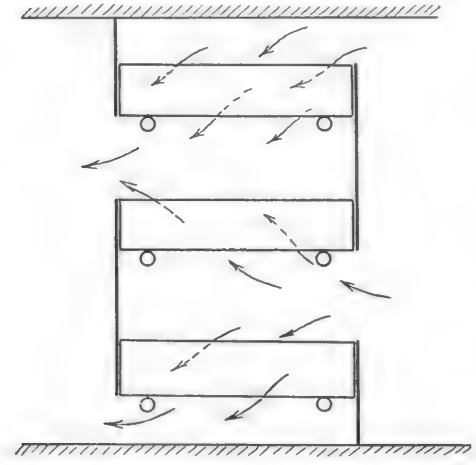

FIG. 2.—FORM OF CAST IRON HEATER FOR USE WHEN CONDENSATION IS TRAPPED TO A RECEIVER AND PUMPED BACK TO BOILERS

TABLE I

Type of radiator	Free air-space per section, in square inches
School Pin	60
Utica Pin	60
Flange Pin	36

The square feet of surface for a heater of this kind, with steam at 10 to 15 lbs. pressure, may be found by the formula C × D ÷ 90,000, in which

C = cubic feet of air to be warmed *per hour.*

D = degrees through which the temperature of the air is to be raised.

Heaters of this type are best supported on I beams resting in the side walls of the fan room. The space for the entrance of air above the heater should be such that the velocity will

not exceed 800 to 1,000 feet per minute. Heaters of this type are commonly divided into six to eight groups or sections, and so valved that any number from one to the whole heater may be used, as the outside weather conditions may require.

About one-third of the heater should be arranged for using exhaust steam from the engine. These sections should be so valved that they may take either live or exhaust steam as desired. The amount of surface required to condense the exhaust will vary according to the outside temperature, being less in the winter months than during the spring and fall. It is well to divide the exhaust portion of the heater into at least three sections, so that its condensing capacity may be proportioned to the requirements at all seasons of the year. In the case of all overhead heaters, the valves in the supply and return branches to the different sections should be symmetrically arranged so that the corresponding supply and return valves can be easily distinguished. All valves, including air-valves, should be easily accessible.

For the layout shown in Fig. 1 the "up-angular discharge" fan is generally used if the distributing ducts are carried at the basement ceiling.

A form of cast-iron heater for use when the condensation is trapped to a receiver and pumped back to the boilers is shown in Fig. 2. This is made up of sections of pin radiators supported upon a rack made up of pipe and fittings. This form of heater is very compact for a given heating surface, and is especially adapted to a fan chamber of limited size.

Fig. 3 shows a section through a fan and heater chamber where a heater made up of wrought iron pipe is used.

The efficiency of a heater of this type depends upon the steam pressure, the temperature and velocity of the entering air, and the depth or number of rows of pipe in the heater. The final temperature is also affected by the same conditions, but in a somewhat different manner.

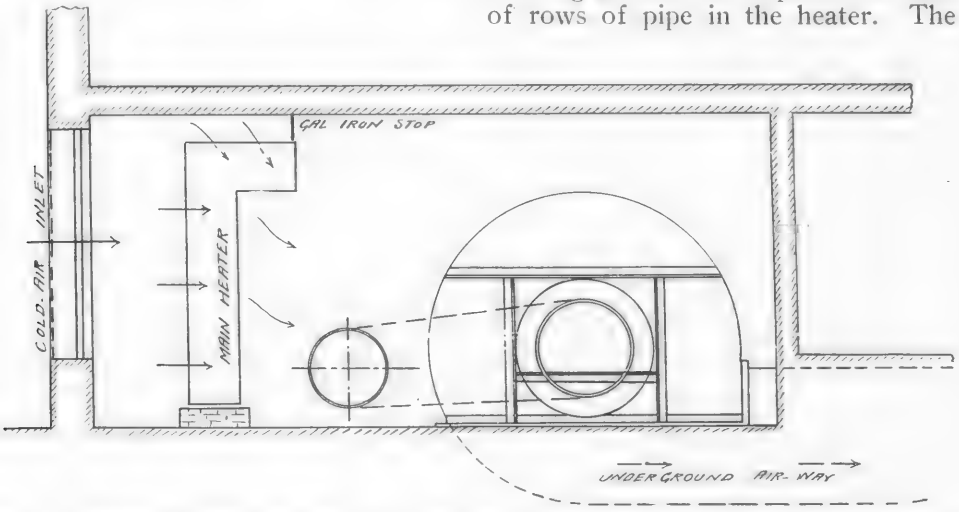

FIG. 3.—SECTION THROUGH FAN AND HEATER CHAMBER WHERE HEATER IS MADE UP OF WROUGHT-IRON PIPE

With the entering air at a given temperature, increasing the pressure and temperature of the steam increases both the efficiency of the heater and the final temperature of the air. Lowering the temperature of the entering air increases the efficiency but lowers the final temperature. Increasing the velocity through the heater, the temperature of steam and entering air remaining the same, increases the efficiency but lowers the final temperature. In brief, the efficiency varies directly as the difference in temperature between the heating surface and the entering air, and also with the velocity of the air over the heating sur-

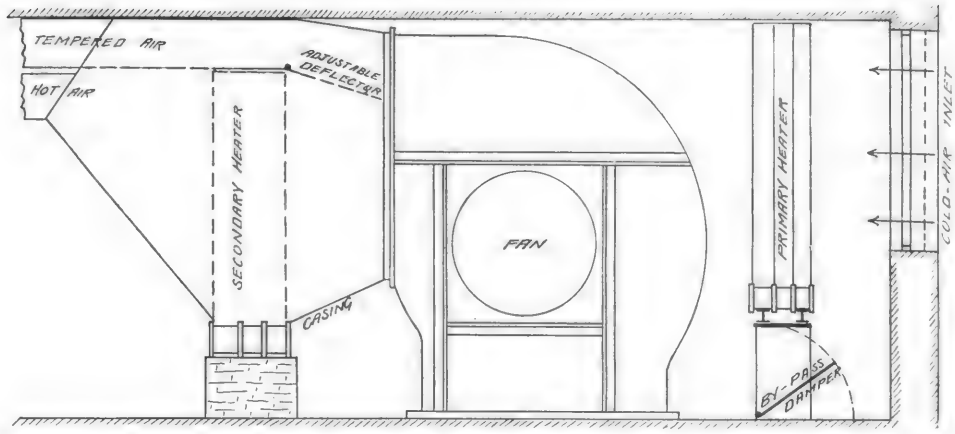

FIG. 4.—ARRANGEMENT OF FAN AND HEATERS FOR THE DOUBLE DUCT SYSTEM OF HEATING AND VENTILATING

face. The final temperature is affected to a certain extent by the above, but more especially by the depth of the heater.

The following table has been made up of the averages from a considerable number of personal tests and others collected from various sources, and has proved to be very satisfactory for general use.

In the table below the temperature of the entering air is taken as zero, and the velocity between the pipes of the heater as 800 feet per minute.

For a velocity of 1,000 feet, multiply the temperatures given in the table by 0.92, and the efficiencies by 1.13.

Fig. 4 shows an arrangement of fan and heaters for the double-duct system of heating and ventilation. In this method of heating, the primary heater is made of sufficient size to heat the total air supply to a temperature of about 70° F. in zero weather. With steam at 5 lbs. pressure or less, this should be 8 or 10 pipes deep. The secondary heater should be about 10 pipes deep, and may contain the same amount of heating surface. Only a

TABLE II

Rows of pipe deep	Temp. to which the air will be raised from O° F.			Efficiency of the heating surface in B. T. U., per square foot per hour.		
	Steam Pressure			Steam Pressure		
	5 lbs.	20 lbs.	60 lbs.	5 lbs.	20 lbs.	60 lbs.
4	30	35	45	1600	1800	2000
6	50	55	65	1600	1800	2000
8	65	70	85	1500	1650	1850
10	80	90	105	1500	1650	1850
12	95	105	125	1500	1650	1850
14	105	120	140	1400	1500	1700
16	120	130	150	1400	1500	1700
18	130	140	160	1300	1400	1600
20	140	150	170	1300	1400	1600

portion of the air will be passed through the secondary heater, but its higher average temperature will so reduce the efficiency of the heater that its size must be increased. The results given are for average conditions of ventilation and building construction, and should be checked for any unusual requirements. The square feet of heating surface in a pipe heater may be found by use of the formula $C \times D \div (55 \times E)$, in which

C = cubic feet of air to be warmed per hour,

D = degrees through which the temperature of the air is to be raised,

E = efficiency of heater from Table II.

Evolution in Heating

I

By J. M. W. Kitchen

[Editor's Note.—*The accompanying article by Dr. Kitchen is the first of a series that will be published in* The Heating and Ventilating Magazine, *detailing and illustrating the theories upon which the author bases his arguments. The paper published herewith is intended to be introductory.*]

Some of the readers of The Heating and Ventilating Magazine are aware that for the last ten years I have been deeply interested in the study of the causes of the enormous heat losses and their prevention, in heating power production, and in various industrial arts; and that I have done much experimentation in this connection with a view to securing accurate data of scientific value. Having arrived at some definite results which I consider of value, I think it may prove of general interest if I present to the readers of this periodical a brief history of the evolution, through which these results have been gained.

This special work commenced in an accidental way by my trying to save fuel in my various greenhouses, (horticulture and floriculture under glass is a hobby of the writer).

Through outside suggestion, a widely advertised fuel saving device was applied to the smoke pipes of the water boilers, with an easily recognized result of an immediate reduction of 20% in the cost of fuel. But the device leaked coal gas, and the inability to control combustion with it in place, resulted in a quick discarding of the device. A few minutes thought concerning the defects to be remedied in such a device resulted in my devising the device illustrated in Figs. 1 to 4; its working parts being indicated in Fig. 1; and its methods of application to and working with heating devices being shown in Figs. 2, 3, and 4. This when applied to my greenhouse boilers was immediately successful in saving 30% of the fuel.

As I know something about scientific matters, it will be surmised that this result very much astonished me. There was no change in the heating surface in this case; and

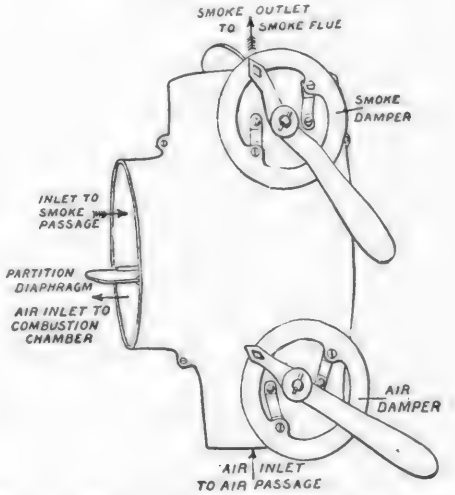

FIG. 1.—FUEL SAVING DEVICE FOR CONTROLLING COMBUSTION IN HOUSE HEATERS

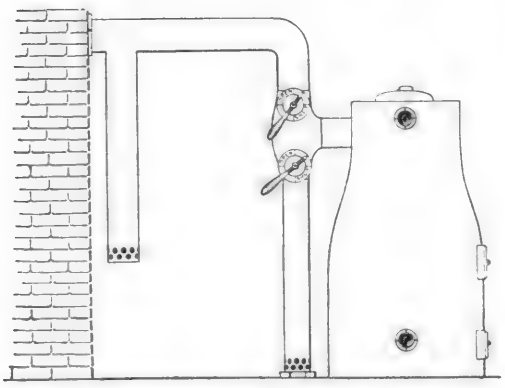

FIG. 2.—APPLICATION OF FUEL SAVING DEVICE TO SMOKE FLUE

no thoroughness of combustion of unburned CO and hydrogen gases would account for so large a saving. Placing the device on a large variety of heaters, I found that the fuel saving effected varied very widely in different heaters, ranging from a gain of nothing, up to as much as 60% in one individual case. These observations led me to commence a study of the reasons of the phenomena observed, and of the broad subject of combustion processes and heat transmission.

Extensive labor in connection with patent proceedings led to an acquisition of historical knowledge in this connection, and finally, experimental disclosures gave me an insight as to the principles that should be applied in heat conservation under various conditions.

It took me about five years to find out how that 30% of saving was effected. I finally discovered that a very considerable amount of the saving was due to an equalization of the rate of combustion, or in other words, in not burning coal in the early part of the night, when its burning is usually objectionable, and yet getting a better combustion later in the night—the burning being effected at a more even rate during the whole period between fuel feeding. It took me several more years to learn the details of pattern making and foundry technique as applied to cast-iron heating devices. I also found out as a matter of experience that the most economical management of the two dampers of my combustion regulator was rather beyond the comprehension and judgment of the average mind deputized to the care of household heaters. This fact determined me to apply correct principles in the construction of those heating appliances that were demanded and bought by the users of such appliances.

PRINCIPLES WHICH SHOULD BE APPLIED IN HEATING

Before giving a list of heating systems and devices in which correct economic principles are applied, it may be of interest to cite some of the more important principles which which are sometimes, or usually, not applied in heating, but which must be applied to secure satisfactory economic efficiency.

There are some twenty avenues through which heat wastes in heating occur, and in designing apparatus for heating, all these avenues should be substantially closed to prevent such wastes.

The first requisite in a heating system should be that of healthfulness; the second qualification is that of being able to effect comfort; and thirdly, it should be economical. Such deadly effects as result from steam or hot water heating without introduction of fresh air for respiration, while widely in use, should be prohibited by law. One can hardly imagine a more

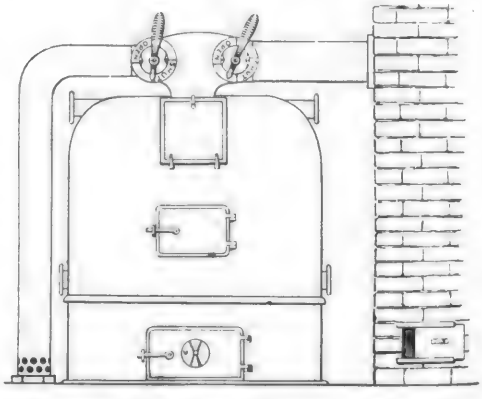

FIG. 3.—ANOTHER METHOD OF ATTACHING FUEL SAVING DEVICE TO HEATER

efficient means for depressing vital energy and promoting infection with disease germs, than the system of re-using breathed air loaded with the effete emanations of the body. Breathing CO^2 is not particularly damaging, though somewhat depressing; but the in-breathing of all of those indefinite emanations of the human body that are breathed in effete air, is something to contemplate with horror. In connection with the application of the principles of securing warm feet and a cooling effect on the head, there is one practice that should be adopted,

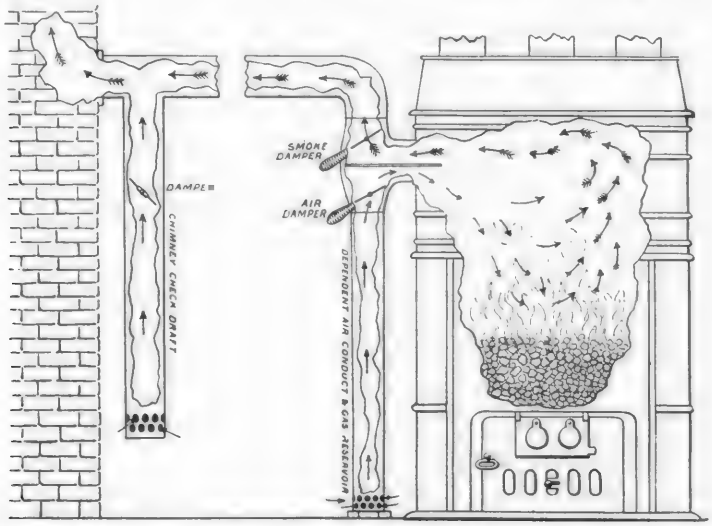

FIG. 4.—COURSE OF AIR AND PRODUCTS OF COMBUSTION IN HEATER EQUIPPED WITH FUEL SAVING DEVICE

and that is not to lathe and plaster cellar ceilings. The main floors of any dwelling should be considerably heated from beneath by connection, while the lathing and plastering allows cool air to be carried into the inter-flooring timber spaces from the cracks between the sills and foundation. If the radiated heat from the cellar heater and heat distributing piping is allowed to rise to the flooring boards of the first floor, much diminution of cold feet is effected.

Another principle to be applied of great importance, is to provide against over-heating of the space to be heated. This is almost universal in steam systems, in which radiation is provided to meet the conditions of very cold weather, and as there is no great variation of temperature in steam of various pressures, the result is, overheating in moderate and very mild weather. The efforts hitherto made to remedy this defect have been very largely ineffective, mostly due to the fact of the uncontrollable fluidity of steam, its expansive properties, and to the further fact that the remedies proposed necessarily involve trained judgment on the part of the manipulator of the means employed. The same difficulty pertains to heating with hot water and hot air, though to a much less degree.

METHODS OF OBTAINING ECONOMY IN HEATING

Economy in heating can be secured if provision is made against losses of heat in the following ways, named among others:

(1) By using less expensive fuel in cases where expert frequent stoking can be provided, (2) avoiding air dilution by proper air feeding, (3) preventing premature cooling of solid fuel and volatilized gases, (4) by providing adequate areas of heating surface, (5) proper arrangement of heating surfaces, (6) securing equalization of rate of combustion,

(7) by the regenerative use of the heat of effete respired air to heat fresh incoming air, (8) securing a counter-current travel of gases and cooled feed-water in the boiler, thus providing a recipient temperature at some part of the boiler to secure the absorption of large volumes of low degrees of heat, (9) cooling feed-water by heating air for respiration with the water of condensation or the return water of hot water systems, and utilizing the cooled feed-water to pick up the low degrees of heat in the boiler that have been hitherto universally lost, it being understood that no lowering of the temperature of the heating gases passing through the boiler can be secured below the temperature of the water in the boiler, (10) securing the heat of waste gases that have passed through the boiler by running them through an air heating economizer.

There are also other applications of principles to which I may refer later on in connection with the distribution of heat in district heating plants.

Health and comfort can also be promoted through efficiency in the provision for controlling draft, by quickly increasing the draft and the rate of combustion or throttling combustion processes to a practical stand-still. Economy may also be practiced by education to a general understanding of the short-sightedness of sacrificing real economic efficiency in order to secure low first cost of installation.

The principles applied in the heating devices illustrated in Figs. 1 to 4 inclusive are: (11) the injection of an over-fire air supply through the smoke nozzle under the accelerating effect of the momentum of a laterally confined column of cold air, this momentum being induced by the expansion and ascension of the burning gases in the combustion chamber, (12) the diffusion and intermixture of air for combustion and the volatilized combustible gases by their relative combat, so to speak, due to the peculiar place of their introduction, (13) preventing the escape of coal gas by the interposition of a confined column of cold air, a heavier gas. This principle is applied both in the introduction of air for combustion and in chimney check-drafting, (14) the effect of gravity in securing the counter-current travel of air and heated gases in contact at different levels, (15) avoiding poor combustion and throwing out of commission areas of heating surface by not introducing over fire air for combustion in the way it is usually done in heating and power generating devices. As it usually is done, more economic loss is sustained than economy gained.

THE IMPORTANCE OF MIXING AIR WITH THE GASES TO BE BURNED

I do not know of any one thing in connection with combustion processes that is of so much importance as this one matter of securing a proper admixture of air with the gases to be burned. With the burning of the gases under atmospheric pressure, to secure approximate perfection of the process, positive air feeding in accurate dosage, both under the fuel mass and over it with forced draft, and in connection with mechanically induced draft, operating through the whole apparatus, is essential.

The next principle in importance for securing economy is the utilization of the wonderful heat transmitting efficiency of the vertical counter-current travel of the heating gases and of cool feed-water. Unless one has seen this process illustrated in practice the results gained are hardly credible. When I have told very eminent scientists that I steam my experimental boiler with a chimney gas temperature of 90° and an atmospheric temperature of 50°, securing a vigorous plunging natural draft by that slight difference in temperatures, my statement is usually not accepted. I know no way of securing definite comparison between the methods of up-travel, horizontal, and plunging

travel of gases, in regard to the efficiencies of heating surfaces arranged in those three ways; but the last arrangement is certainly enormously superior.

Perhaps the next most important principle to be applied is in preventing the premature loss of heat in both solid and gaseous fuel. Reduction in the critical combustion temperature means the formation of cinders and unburned gas around the periphery of the fuel mass, the formation of slag in the center of the fuel mass, injurious action to the grate bars, and defective burning of the volatilized gases.

In further illustrating the application of these principles it is proper to first show several heating systems suited to different conditions. It must be understood that no one system or type of heating device is applicable to all conditions. To cover the field commercially in advanced methods of heating, at least four systems are required, and over five types of fuel burning devices.

(*To be continued*)

The Schott Systems of Central Station Heating

By J. C. Hornung

A wider knowledge of the conditions and principles involved in central station heating is needed by the average heating engineer than in the past, and any information bearing on this subject is therefore, especially timely. In a paper read recently before the Associated Engineering Societies, of Boston and published in the proceedings of that body, the author, Mr. J. C. Hornung, describes in the following interesting manner, the Schott systems of central station heating:

By way of introduction I will first give a very brief history of central station heating, of both steam and hot water, especially as applied to the art from a practical commercial standpoint.

Steam, under varying pressures, and from various sources, has been used for house warming a great many years, and this kind of steam heating is pretty generally understood, but exhaust steam as applied to the heating of more than one building, or, to speak more correctly, as supplied from a central station, has been in practical use for a period of about thirty years, and then only in a more or less limited way.

The system as brought out about thirty years ago was then known as the Holly System. Limited as was the territory which was then attempted to be covered, many difficulties at once became apparent, principal among which were the loss through the pipes by radiation, the linear expansion and contraction of the pipe lines, due to the wide range of temperatures within the pipes, and the pressures required to produce circulation. All of these difficulties have been overcome; some entirely, and others to a point where they are no longer considered serious.

Heating from a central station by utilizing the exhaust steam and transferring the latent heat units to water, which becomes the heating medium, was first tried on a commercial basis along in the nineties by Homer T. Yaryan, of Toledo, Ohio. His scheme was simply to conduct the exhaust steam from a reciprocating engine to a surface condenser, thereby transferring the heat to the water, which, by means of pumps, was kept in constant circulation through the radiators. This method called for two pipes of equal

size, which were laid side by side in the trench, the one serving as a heat-carrying pipe and the other as a pipe to carry the water back to the plant for reheating. Each building was connected in parallel on the mains similar to the parallel system of commercial lighting of to-day, the drop in temperature due to the house-warming coils being analogous to the drop in potential between the two wires.

About this time a one-pipe system of hot-water heating was brought out which was an enlargement of the systems commonly in use within the buildings; that is, a single pipe belt was run around a block and the various buildings were shunted off the belt similarly to the arc-lighting systems in common use to-day. This system requires that the pipe shall be of the same size throughout the belt, and the number of heat units which can be supplied is determined by the allowable drop in temperature between supply and return ends of belt; as in arc lighting when one belt is loaded an additional belt may be run from the power house.

In 1897, Mr. W. H. Schott saw the possibilities of central station heating and developed first the balanced column system of hot-water heating and a year or two later the regulated steam system. From time to time variations from the systems already mentioned have been attempted, but weakness in designs and lack of determination to perfect have caused a withdrawal from the field.

The paper will now take up the Schott Systems, viz., the Balanced Column Hot-Water System and the Regulated Steam System, of which the steam system is at present being installed in Salt Lake City.

Balanced Column Hot Water System

For convenience, and since the fundamental principles were worked out from a water standpoint, we will first consider the hot-water system.

The general station arrangement of this system is shown in a conventional way as indicated by Fig. 1. The exhaust from any steam engine

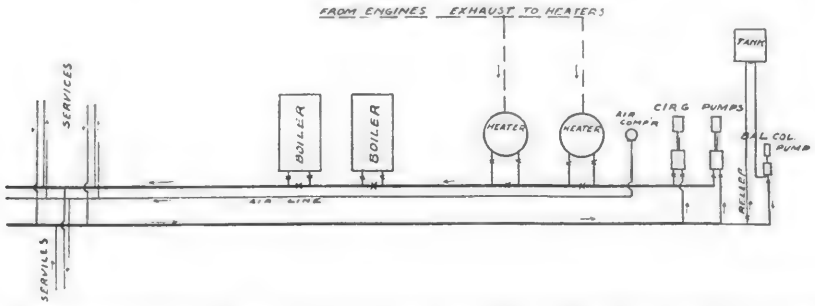

FIG. 1.—ARRANGEMENT OF STATION FOR SCHOTT HOT WATER HEATING SYSTEM

enters the heaters or condensers, which are of the surface type and built in such a manner that the exhaust does not come in contact with the circulating water. As a matter of fact, the condensers do not differ in their functions from a condenser used in a standard condensing power plant, except that instead of circulating the water through cooling towers, thereby dissipating the heat, we circulate it through house warming coils.

The condensers are usually connected so that no back pressure comes upon the engine, and the water of condensation is handled by a tank receiver pump which delivers it automatically to an overhead tank and from which it again flows by gravity to the feed-water heater. An even and accurate supply and temperature of feed water is hereby made possible.

When the situation warrants, a vacuum pump may be placed on the condensers and operated at vacuums which are inversely proportional to

the temperature required in the circulating water. Another advantage of this feature, where cooling water may be had during the summer, is that the station equipment of the heating system may be kept in commission throughout the year.

The water of condensation with some make-up water is also used for keeping the distributing system filled, thereby avoiding the annoyance of scaling in the pipes and radiators, which, in the early state of development, was a serious trouble.

The separation of the cylinder oil from the steam is, of course, taken care of before steam enters condensers by the use of efficient oil separators.

The circulating pumps, which are usually of the piston type on a two-pipe system, are automatically controlled on the steam inlet so that a constant pressure is maintained, and, in conjunction with the house temperature controllers, operate to avoid any excess pumpage, which naturally tends toward greater capacity and the elimination of wasted heat units.

Centrifugal pumps of the ordinary type have not been brought into general use on account of varying conditions imposed; that is, varying pressures due to varying loads or elevations and varying quantities of water required due to varying temperatures. This applies to a two-pipe system and clearly demonstrates that automatic regulation is highly essential where heat is sold on a flat basis, and this, by the way, is the only basis for hot-water heating today, as no one so far has been able to devise a successful means for measuring this service.

VARIATIONS IN PUMP LOAD

An interesting pumpage chart may be plotted for any given 24 hours. Observation of such chart would show that during the night hours the pumpage is lowest and that during the morning house, when doors and windows are thrown open, the pumpage increases until about 10 o'clock, when it again decreases until evening, when another increase appears. This applies when the outside temperature is normal, but now we have another and much more severe condition to meet, and that is the sudden fluctuation in outside temperatures. Our records show that a drop of 40° in less than one hour is not uncommon, and on such occasions the acceleration of speed of pumps, and incidentally of the firemen, is, indeed, interesting to note.

The efficiency of centrifugal pumps over piston pumps is, of course, fully established, but since the exhaust which has lost none of its latent heat units is at once passed on to the condensers, the net efficiency is not different to any degree.

The boilers as shown are simply the steam boilers employed in any power or electric plant, and are connected so that at will they may be converted into circulating boilers. This change requires about twenty minutes, and with it the highest efficiency is obtained, where it is necessary to make up a deficit with coal direct when exhaust is insufficient, due to the fact that boilers operate under low tube and stack temperatures; virtually, they become economizers.

The air compressor is of the loco-

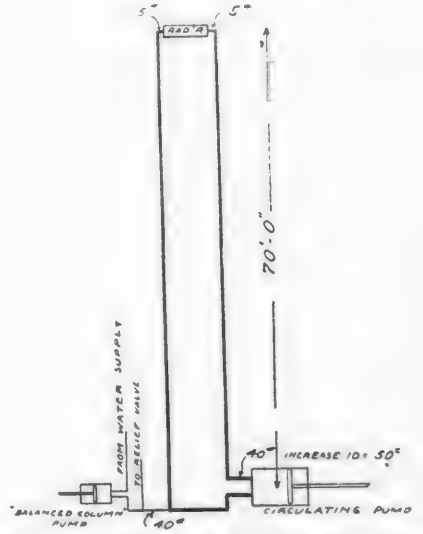

FIG. 2.—DIAGRAM OF BALANCED COLUMN FEATURE IN SCHOTT HOT WATER HEATING SYSTEM

motive type and supplies approximately 15 lbs. of air to the thermostats, which operate the individual temperature controllers placed on each of the several buildings on the line. The detail of these regulators will be taken up later.

Follow now the circulation from the pumps through the condensers, which may be cut in or out; then to boilers, which may be by-passed or cut in series; then on to the houses which are connected across the mains; water passing through a given house but once before returning to the station for reheating.

The limit of business can at once be seen to be governed entirely by the size of mains and the heat generating capacity at the station. Distance is governed only by the investor. Two miles distant is not uncommon, and greater distances are practicable. A drop of 1° in temperature in 1 mile of pipe line ordinarily represents the loss.

Following the return pipe back to the station, it will be noted that it connects direct to suction of pump with no other connection save the balance column pump and relief valve.

THE BALANCED COLUMN PRINCIPLE

Fig. 2 shows the principle of the "balanced column." Essentially this system is a closed system, so that one leg of the pipe line balances the other, and in practice the circulating pumps are required to overcome the friction in the lines only, while the balanced column pump simply maintains the static pressure in the return leg by keeping the system full of water. This item in a tight system is naturally very small.

The elevation of 70 ft., as shown, may be in a mile or more of pipe and the "radiator" may represent several hundred thousand feet of radiating surface scattered over a wide territory. The relief valve is usually connected to a branch pipe of small diameter and the discharge flows back into supply tank. This valve operates only when the water expands, due to the rise in the temperature when more heat is required.

Automatic control of temperature in the various buildings is obtained by placing the main control valve in the return pipe just before it leaves the building. The valve is operated by valve stem which is attached to a diaphragm, and this in turn is operated by air pressure supplied from the central station. The amount of air supplied, and hence the position of valve stem, is controlled by a thermostatic device placed at a convenient place on an inside wall.

When the temperature tends to rise above a predetermined point the air is simply allowed by the thermostat to act upon the diaphragm, and when the temperature tends to fall the thermostat relieves the air pressure, allowing the valve to open. Very close regulation is in this way obtained, and according to various tests made the reduction in pumpage will average about 30%.

For practical purposes and to aid in design, a schedule of boiler capacities at varying outside temperatures has been carefully worked out. Take, for instance, 40° above zero, which is an average temperature point, and with water circulating at 150°, a water tube boiler of 100 HP. rating will handle 36,500 sq. ft. of radiation. A fire tube boiler will handle 31,000 sq. ft., and a surface condenser, using exhaust steam, will handle 19,200 sq. ft. At 0°, which is an average low temperature point, with water circulating at 200°, the machines will handle 20,000, 17,400 and 11,500 sq. ft., respectively. For steam heating the boiler capacities will run from 5% to 6% less, due to higher tube and stack temperatures.

The amount of radiation which can be carried on any given line depends on a great number of conditions, principal among which are size, length, turns, elevations and class of service. However, in general practice an 8-in. line will carry 52,315 sq. ft. at a water velocity of 250 ft. per minute at a loss of 0.5

lbs. pressure in 100 ft. The service pipes for both hot water and steam heating are usually graded toward the mains, and for, say, 2-in. service, 100 ft. long, 3000 sq. ft. of water radiation can be handled, while the same service for steam will handle 424 sq. ft.

The insulation of the heating mains against loss of heat by radiation is probably the most important feature in connection with the distributing system, and hence several schemes have been adopted to limit this loss. Layers of wood with air cells between filled with an adaptable nonconductor have been successfully used for some years. The wood insulation, which is ordinarily of No. 1 hemlock, gives very high efficiencies and under normal conditions a long life. The general tendency nowadays being toward greatest permanency, a concrete conduit has now been adopted, and with an approved filler, usually of asbestos, properly filled around the pipe, we get an insulation which is absolutely permanent and highly efficient. The insulation proper being largely in the filler, the greater requirements of steam as compared with water are met by leaving more space to fill.

When the soil is wet an effective underdrain is necessary to prevent moisture from coming in contact with pipes, as this undoubtedly has been one of the most serious difficulties in operating a heating plant successfully.

Expansion and contraction of pipe lines during the heating season are factors of interest, since for every 100 ft. of line a travel of at least 2 in. must be allowed for. Taking a Salt Lake block, for instance (792 ft.), we have about 15 in. more pipe in a block in winter than we have in summer. The differences are taken care of with metallic packed joints of special design; for hot water about 400 ft. apart and for steam about 150 ft. apart, each joint being placed in an accessible manhole. In steam practice all fittings and valves are flanged, and services are taken off only at points where fittings are accessible.

Concerning the coal consumption per square foot of radiating surface per hour, per day and per heating season, some very interesting data have been gathered and compiled from many plants scattered throughout Ohio and Indiana.

Table I shows results from Indiana slack, based on a season of 5,280 hrs. at a net efficiency of 60% —that is, 60% of the total calorific value of the coal was delivered by the radiator. The radiating surface in this case was the ordinary cast iron bronzed radiation, mostly of standard heights.

TABLE I.—COAL CONSUMPTION AT VARIOUS TEMPERATURES.
Season of 5280 hours. Indiana slack coal: 10,500 B. T. U.
Efficiency = 60%. Temperature of room, 70°.

Mean temperature of water Deg. F	Outside temperature Deg. F	Heat units per hour	Pounds coal per hour	Pounds coal per day	Pounds coal per season
220	—30	306	0.047	1.128	248.16
212	—22	280	0.044	1.056	232.32
210	—20	275	0.0437	1.049	230.74
200	—10	246	0.0390	0.936	205.02
190	0	221	0.0351	0.842	185.32
180	10	195	0.0310	0.744	163.68
170	20	170	0.0270	0.648	142.56
160	30	146	0.0232	0.556	122.32
155	35	136	0.0216	0.518	114.05
150	40	124	0.0197	0.472	103.84
140	45	102	0.0162	0.388	85.36
130	50	82	0.013	0.312	68.64
120	55	66	0.0104	0.249	54.78
110	60	51	0.0081	0.194	42.68
100	65	44	0.0070	0.168	36.96

One of the most difficult problems in central station hot water heating is the accurate determination of the amount of radiation to be set in any given room or building. This is due to the fact that the consumers pay on the number of feet set and the producer must guarantee temperatures. Either a slight excess or insufficiency will naturally cause complaint. The result, however, of this extreme care is satisfactory, since the consumer is given a service which cannot be excelled.

In arriving at radiation requirements some interesting results are obtained, one in particular as concerns the standard cast iron radiator, viz.: At a mean internal temperature of 170° and an external temperature of 70° the surface will emit 170 B.T.U. per square foot per hour, but for any increase or decrease in mean internal temperatures there is a logarithmic rather than a proportional increase in heat emitted. However, it is possible to plot curves from which, for any given internal temperatures, the heat emitted can be determined. It is also possible to plot curves for heat transmission through glass or exposed walls, and with these data tables may be compiled for any requirements met in commercial practice.

Table II gives coefficients for glass, exposed walls and cubic contents which have demonstrated their accuracy.

STEAM HEATING SYSTEM IN SALT LAKE CITY

Concerning the steam heating plant which is at present being installed in Salt Lake City, we have, for generating electrical current, the two-stage vertical turbines taking steam at 150 lbs. pressure. The steam for heating purposes is taken from the first stage of the turbines and carried through a 16-in. low pressure main to a well established center of distribution which is located in the heart of the commercial district.

The steam passes from turbine to heating main through an automatic regulating valve, specially designed, and capable of adjustment for delivery pressure varying from 0 to the initial pressure, and at such predetermined adjustment will hold the delivery pressure constant regardless of variation in the initial or turbine pressure. Direct from the high pressure steam header in the station is run a 6-in. line which feeds directly into the center of distribution, and from this center is also carried a small pressure indicating line back to power house so that the attendant knows at all times what his uptown pressures are.

There is also a high pressure injector of special design placed in the low pressure main where it leaves the power house, so that when the turbines are running light a small deficit may be supplied without putting into operation the high pressure line. This injector is so designed as to put no increased pressure on the turbines. One feature of this system is that the turbines run condensing on the second stage the same as though the first stage had been normally operated.

The condensation after passing through the meters is returned to the station from such territory as lies above the plant. Otherwise it is turned through cooling coils into the sewer. The regulation of heat in the various buildings is handled the same as for hot water, except that in the case of steam the main controlling valve is placed on the supply pipe as it enters the building.

To meet the growing demands for a more complete service the Schott systems have devised their own air valves, condensation meters and low pressure traps. The air valve is known as the Auto-vac valve, and, stated briefly, it allows air to escape from the radiator but no steam or water, and it allows no air to return to the radiator through the valve. In construction it is simply a brass case containing a diaphragm, a check valve and a generous float which floats in water and expands in steam.

The meter is known as the Combi

TABLE II—CENTRAL STATION COEFFICIENTS FOR HEAT TRANSMISSION

Based upon 6 pounds of water per square foot of radiation per hour. Water entering radiator at 212° and leaving at 175°. Decorated radiator emitting 225 B. T. U. per square foot per hour at 70°. Mean temperature of radiator, 190° at 20° below zero.

Kind of Surface		Temperature of Room 55°	60°	65°	70°	75°	80°	85°	99°
Single glass, loose		.58	.64	.69	.73	.77	.81	.85	.90
Single glass, tight		.48	.53	.57	.60	.64	.68	.72	.75
Vault light glass		.57	.03	.68	.72	.70	.80	.84	.89
Single skylight		.42	.455	.49	.52	.55	.59	.62	.65
Double skylight		.24	.26	.28	.30	.32	.34	.36	.38
Good Door ½ Glass		.26	.28	.30	.32	.34	.36	.38	.40
Double Glass (Storm Windows)		.225	.24	.26	.28	.30	.32	.34	.36
Average Frame	N. & W.	.175	.19	.20	.22	.23	.24	.26	.27
Average Frame	S. & E.	.16	.175	.18	.20	.21	.22	.24	.25
8″ Brick Wall or	N. & W.	.16	.175	.19	.20	.21	.22	.24	.25
Well Constructed Frame	S. & E.	.155	.16	.17	.18	.19	.20	.22	.23
Back Plastered Frame	N. & W.	.13	.14	.15	.16	.17	.18	.19	.20
Back Plastered Frame	S. & E.	.11	.12	.13	.14	.15	.16	.17	.18
12″ Brick Wall	N. & W.	.11	.12	.13	.14	.15	.16	.17	.18
12″ Brick Wall	S. & E.	.09	.10	.11	.12	.13	.14	.15	.16
17″ Brick Wall	N. & W.	.09	.10	.11	.12	.13	.14	.15	.16
17″ Brick Wall	S. & E.	.07	.08	.09	.10	.11	.12	.13	.14
Ordinary Floor or Ceiling		.04	.0425	.045	.048	.05	.053	.057	.06
Fire Proof Floor or Ceiling		.02	.0225	.025	.0275	.03	.0325	.034	.035

Consider floor when basement piping is covered or basement is not otherwise heated, and if basement is not tight, add 10 per cent. to 25 per cent.

Consider ceiling if attic is unfloored or otherwise unprotected.

If rooms or walls are open to attic or other open unheated space, add 10 per cent. to 50 per cent.

When building is exposed to severe winds, add 10 per cent. to 25 per cent.

Multiply by 0.6 for steam systems.

Changes of Air per hr.	Temperature of Room 55°	60°	65°	70°	75°	80°	85°	90°
½	.003	.0032	.0034	.0037	.0039	.0042	.0043	.0045
1	.006	.0064	.0068	.0075	.0077	.0083	.0086	.009
1½	.009	.0096	.0102	.011	.0115	.0125	.0129	.0135
2	.012	.0128	.0136	.0146	.0154	.0166	.0172	.018
2½	.015	.016	.0172	.0183	.0192	.0208	.0215	.0225
3	.018	.0192	.0206	.0219	.0228	.0249	.0258	.027
3½	.021	.0224	.0240	.0255	.0264	.0291	.030	.0315
4	.024	.0256	.0274	.0291	.030	.0332	.034	.036
4½	.027	.0288	.0306	.0333	.0351	.0378	.0387	.0405
5	.030	.0320	.0340	.0305	.0385	.0415	.0430	.045
5½	.033	.0352	.0374	.0407	.0429	.0462	.0473	.0495
6	.036	.0384	.0408	.0438	.0462	.0498	.0516	.054

Multiply by 0.6 for steam systems.

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recording steam trap, since it acts as a trap as well as a meter. In construction it is a cast iron case capable of holding 50 lbs. of water and a float which simultaneously actuates a pair of valves connected with a walking beam so that one of them is open at all times. When the outlet valve is shut and the inlet valve open, the trap continues to fill until 50 lbs. of water have been received. At this point the float actuates the mechanism which instantly reverses the position of valves and the trap operates until 50 lbs. have been discharged, when the float again causes the mechanism to put the valves in original position for refilling. Each discharge of 50 lbs. of water is recorded on dial placed on outside of meter, and this dial reads directly in pounds of water, eliminating the necessity of conversion factors.

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DURING the "recent unpleasantness," to apply a Civil War term to the business troubles of the past year, the dulness in the heating trade has not been without its compensating features. One of the most noteworthy of these is the opportunity it has offered business men to catch up with the technical side of their profession. We have already referred in these columns to this phase of the panic It is not so easy to-day as it was a year ago to find the progressive engineer who is not well informed as to the new developments described from month to month in the technical journals and the cry, "We are too busy to read the trade press," has remained to carry its own rebuke to those who uttered it. Unmistakable evidence of the advantage taken by many of their additional leisure hours is to be seen in the increasing number of tests reported and of studies undertaken, at least in the heating field, which can not fail to benefit the profession at large. Some of this activity, and, we may say, a most important part of it, will be reflected in the columns of THE HEATING AND VENTILATING MAGAZINE during the coming months and it may well be questioned whether matter involving such painstaking care and conscientious study could have been made available to the public had it not been for the enforced dulness of the past season.

SUCH periods, it is said, come but once in a decade and in the modern development of heating and ventilating, it marks one of the few pausing places in its history. Moreover, if present conditions may be relied upon, it will be a long day before the profession will have the same opportunity to collect itself, as it were, and start out from its new bearings. The eyes of the business world are already fixed on the signs of a renewal of prosperity that will mark a new epoch in the commercial history of the country. It will be a time that will challenge the technical, as well as the practical equipment of every man brought within the whirl of the approaching boom, and in that respect the golden opportunities now being offered in the way of study and research will tell heavily in the years immediately to come.

HERE is heresy in high quarters. President-elect William H. Taft, in an address delivered not longer than a day following his election, at the laying of the corner stone of the new Woodward School in Cincinnati, said, in terms that could not be mistaken: "It seems to me that the smell that used to pervade Old Woodward was

necessary really for the make-up of a thorough-going man." We confess to a lively sympathy with the horror felt by the heating and ventilating engineers in his audience until Mr. Taft relieved their suspense by the qualifying statement, "That, doubtless, is not true and I withdraw the remark if it is to be construed in a serious way. Perhaps, however, now the campaign is over, it will not be quoted against me!" As a matter of fact the mechanical plant in this particular institution, including the heating and ventilating arrangements, are, we understand, in keeping with the most approved modern practice and beneath the irony of the President-elect's comments was really a high and deserved compliment of the striking improvements shown in the construction of this particular type of building.

SOME curious results of experiments to ascertain the amount of carbonic acid gas in the air in certain parts of England, as well as the amount of carbonic acid gas given off by different persons under different conditions, were described recently by Mr. W. Thomson speaking before an English society of sanitary engineers and reported in the Compressed Air Magazine. Using the method of forcing air into a bottle with an ordinary pair of bellows and submitting it to a simple chemical test, the results of his experiments showed that the amount of carbon dioxide which a man breathed out depended upon the quality of the air by which he was surrounded. In Manchester he breathed about 4% and in the country 5%, so that it would appear to be necessary to take about one-fourth more food in the country than was sufficient in town. The breaths of three men were tested. In Manchester the percentage of carbonic acid gas given off by each was —A 4, B 3.8, and C 4. At the Buxton golf links, 1,000 feet above sea level, the figures were 5, 5.2, and 5.2, and after they had played eighteen holes and had lunch they each gave 4.8%. They then drove to the Cat and Fiddle, 1,700 feet above the sea, and there A gave 5.2, B 5.4, and C 5.4. These results suggested that the amount of carbonic acid gas exhaled was influenced by altitude. But a test made at Blackpool did not sustain the theory.

He found, too, that when the air was inhaled through the mouth the breath was about 0.2% lower in carbon dioxide than when the nostrils alone were used. This was suggested to him that if the air were artificially heated a still greater oxidization would take place in the body. Air heated to 140° centigrade was breathed, and the exhalation contained 5.4% of carbon dioxide, whereas exhalation of ordinary unheated air from the same person gave 4.4. The average in a number of experiments gave 4.1 from ordinary air and 5.1 from heated air. When pure oxygen was breathed the exhaled air gave an average of from 4.4 to 4.5, which was considerably below what one got from breathing in the country. It would appear, therefore, that country air was better for reviving people who had been asphyxiated or nearly drowned than pure oxygen, and that a maximum effect would be obtained from warmed country air and oxygen combined. It was found, however, that the hot air breathed in a Turkish bath had not the same effect as hot air breathed when the body was only at its normal heat.

Electric Heating

By W. S. Hadaway, Jr.

While much has been accomplished in the field of electric heating as applied to lighting, metal welding and forging, and to electric furnaces for various industrial operations, the application of electricity for low-temperature heating, generally diffused and in large volumes, suitable for house-warming purposes, has left wide gaps to be filled. It is interesting, therefore, to notice in a recent discussion of the general subject of electric heating, presented November 13, 1908, before the American Institute of Electrical Engineers, by W. S. Hadaway, Jr., that the speaker took occasion to review what had been accomplished, as well as the lines upon which further progress should be made, in the application of electricity on a commercial scale to the warming of buildings. The main features of Mr. Hadaway's paper concerning this side of his subject are contained in the following abstract:

It may assist in a better understanding of the terms used in discussing electric heating to state at the outset that the words heat potential, etc., are employed more specifically than has generally been found necessary in discussing heat effects apart from electricity. Heat, like electricity, is assumed to flow from a surface of high potential to one of low potential. Quantity or volume of heat is analogous to quantity of electricity. Unit quantity is here figured as the British thermal unit, though for electrical purposes it is, of course, the calorie. Temperature corresponds to potential. Heat potential is as true an expression of potential as is impressed electromotive force; it should not, however, be comfounded with static potential, a term used in discussing energy of gas. It would materially simplify thermal nomenclature if a word were coined to designate heat potential in the same manner that electromotive force expresses electrical potential.

The term "electric heating" is commonly used to express the filtering down of the higher potential energy of electricity into the lower potential energy of heat. There is no well defined line of demarcation; the result is inseparable from the conveyance of utilization of electricity in any degree. The expression is, therefore, a meaningless one from the heat engineer's standpoint and it fails accurately to express the performance of useful work by the transmission of heat energy to a distance by means of electricity. The expression, "electricity, a factor in a telethermic system," would be a better definition, but for obvious reasons the shorter and simpler expression is employed.

Heat energy is to be regarded as a commodity that can be generated or controlled in convenient form and distributed and sold, and in which electricity is used either directly as the high-potential heat factor or indirectly as agent.

The feature of the subject we are to consider is the practical adaptability of commercial electricity for heating purposes and for performing useful work under the conditions imposed in general industrial and domestic life, and particularly in connection with other heat distributors for a multipotential heat supply.

TWO CLASSES FOR APPLYING ELECTRICITY FOR HEATING PURPOSES

These applications may be roughly divided into two classes according to the degree of concentration of the heat energy used. The first class includes low-temperature heating, generally diffused and in large volumes: the second includes high-temperature heating, generally localized and in small quantity.

In heating on a small scale no adequate classification is possible: it is the blending of high-potential heat energy into low potential-heat work for many useful operations that primarily suggests the feasibility of heat

transmission by electricity. An arbitrary line of temperature demarcation for heating on a large scale has been drawn at 250° F.

The closest common analogy to the differences between low-potential, large-volume and high-potential, small-volume heating is the distinction between volume and pitch in sound. As examples of the first class may be cited the heating of rooms and of water at atmospheric pressure; examples of the second class are electric ovens, sad-irons, and soldering-irons.

The electrical unit or kilowatt-hour is the equivalent of 3412 B. T. U. For practical purposes the work in hand is to determine the useful work in different lines obtainable from this number of heat units at a fair average cost of supply. There is involved indirectly the determination of relative efficiency between electric and other methods of heat generation, distribution, and application.

Figures tabulated farther on will show results obtained in water heating by various methods of heat application. The heat capacity of the work performed is sufficiently large to express the relative differences in combined efficiency, and, as we should expect, the lower the temperature of the work the larger the area heated; and the greater the capacity the less the difference in ratio between heating by combustion and by electricity. We may readily determine the conditions where the ratio is an inverse one.

CALCULATIONS FOR ROOM HEATING

In room-heating apparatus on continuous run we may estimate that one watt-hour, 3.41 thermal units, will heat 1 sq. ft. of common radiator surface through 1.26° F. that 1000 watt-hours or 3410 thermal units will heat the surface approximately 126° F. above the room temperature; that is, for room heating, from 85 to 110 watt-hours are practically the equivalent of steam at low pressure condensed by 1 sq. ft. of radiator surface with the difference between the room and the radiator temperatures as above stated. This, of course, takes no account of the heat capacity of the apparatus, which is practically eliminated by the imposed conditions of continuous running.

We may safely assume that a fair average price of the electrical unit from large steam electric stations is 6.7 cents. It would therefore cost 0.65 cents average to run 1 sq. ft. of direct radiation surface for one hour, or the electrical unit would keep about 10.3 sq. ft. of radiator surface at the temperature difference noted for one hour.

COMPARISON WITH STEAM HEATING

Direct comparison of this value with practical steam heating is difficult, owing to the variables involved. We may, however, compare it with a central station steam distributor as quoted by Unwin in his work on the "Development and Transmission of Power," referring to a New York steam company.

The unit of heat used by this company is defined as the "kal", which is stated to be the heat required to evaporate one pound of water from 100° F. at 361° F. or at 85 lbs. pressure per square inch. One kal is therefore about 1.110 thermal units. On a sliding scale the charge is stated to be 70c. per 1000 kals to small users and 40c. per 1000 to large users. As the price of 6.7c. per electrical unit is to a fairly large user, we shall compare it with the 40c. per 1000 kal rate. For 40c. the consumer obtains 1,110,000 thermal units from the steam station, composed with 20,400 thermal units from the electric station, a ratio of nearly 54 to 1, or practically 50 to 1 as a loss must be figured in the case of steam, dependent upon the temperature at which the condensed water is allowed to escape.

It is interesting to note in passing that while the relative efficiencies of generations are about as 12 to 1, the commercial rates quoted are as 50 to 1. The ratio of the cost of heat energy from the electric station to the cost from the steam sta-

tion is therefore practically four times as great as the ratio of the relative costs of production. This disparity should be considered in discussing the influence and importance of the load-factor as discussed by Crompton in his paper on "Electric Energy."

(To be Concluded)

The Weather for October

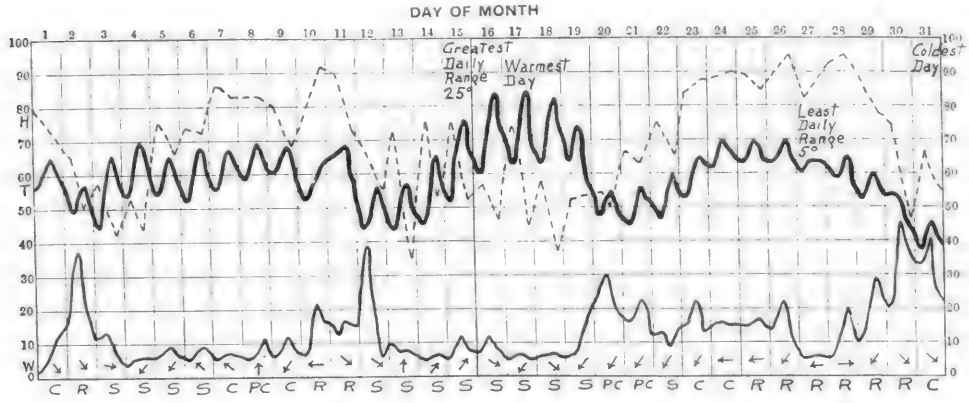
The opening of another heating season was marked with somewhat warmer weather than usual, New York in particular showing a mean temperature for this month of 60°, against a mean of this month of 38 years of 56°. The other cities from which detailed reports were received nearly all showed slightly higher temperatures than are normal at this time of year. In all cities except Boston a continuation of last month's drought was experienced.

NEW YORK

Highest temperature, 84°, on the 17th; lowest temperature, 38°, on the 31st. Greatest daily range, 25°, on the 15th; least daily range, 5°, on the 27th. Mean temperature for the month, 60°, 4° above the mean of this month for 38 years. Total rainfall, 1.92 in., about 1½ in. less than usual. Prevailing direction of wind, northeast; total movement, 8,470 miles; average hourly velocity, 11.4 miles; maximum velocity (for five minutes), 50 miles per hour from the northwest on the 30th. There were 14 clear days, 6 partly cloudy and 11 cloudy. Rain fell on 9 days.

PITTSBURG

Highest temperature, 80°, on the 16th; lowest, 34°, on the 3d. Greatest daily range, 39°, on the 4th; least daily range,


DAY OF MONTH
Greatest Daily Range 25°
Warmest Day
Coldest Day
Least Daily Range 5°
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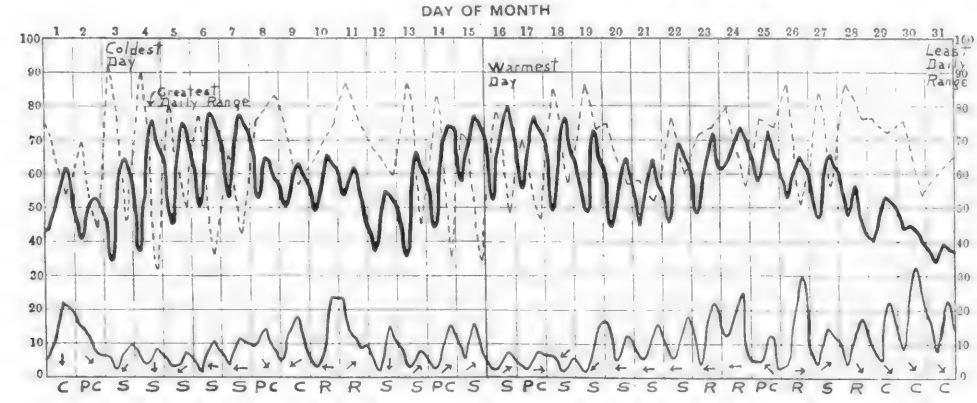
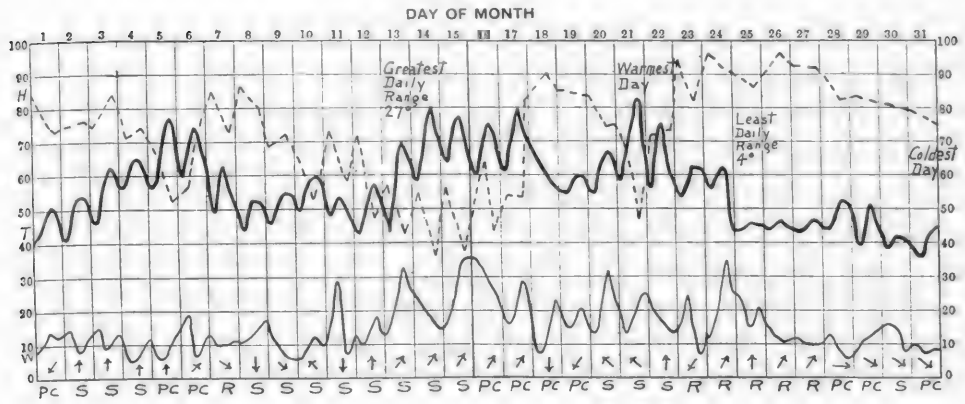
RECORD OF THE WEATHER IN NEW YORK FOR OCTOBER, 1908



RECORD OF THE WEATHER IN PITTSBURG FOR OCTOBER, 1908

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau

Upper line indicates temperature in degrees Fahr.
Broken line indicates relative humidity in percentage from readings taken at 8 a. m. and 8 p. m.
Lower line indicates velocity of wind in miles per hour.
Arrows fly with prevailing direction of wind.
S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain.


DAY OF MONTH
Greatest Daily Range 27°
Warmest Day
Least Daily Range 4°
Coldest Day
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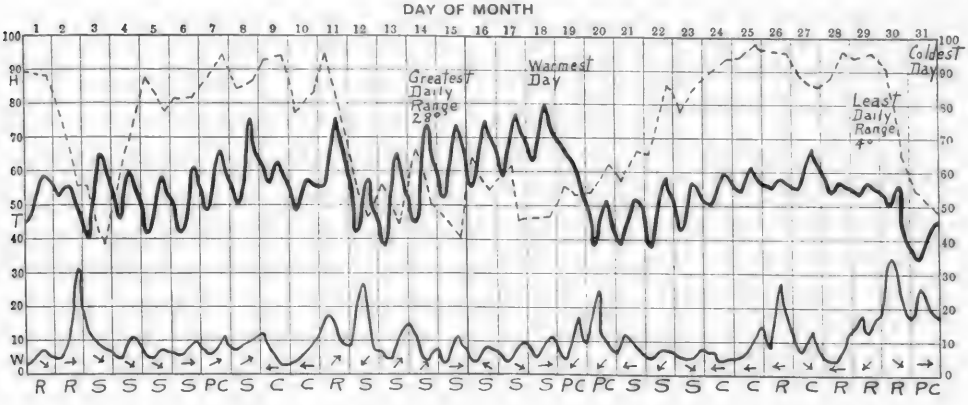
RECORD OF THE WEATHER IN CHICAGO FOR OCTOBER, 1908


DAY OF MONTH
Greatest Daily Range 29°
Warmest Day
Coldest Day
Least Daily Range 4°
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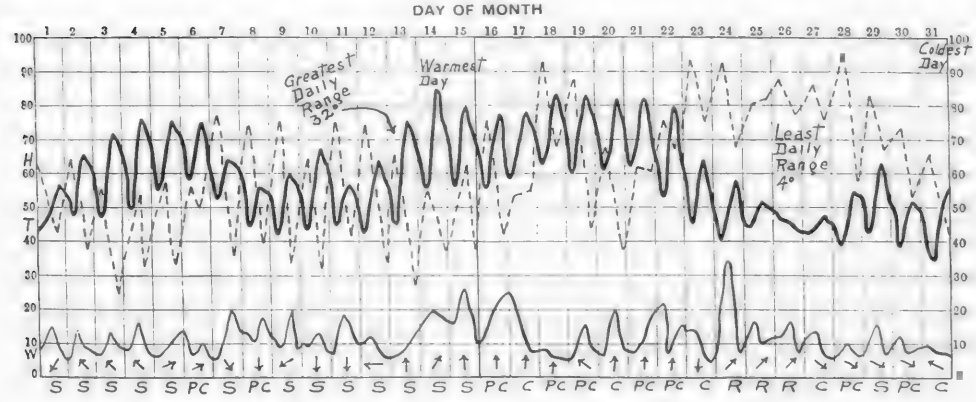
RECORD OF THE WEATHER IN BOSTON FOR OCTOBER, 1908


DAY OF MONTH
Greatest Daily Range 32°
Warmest Day
Coldest Day
Least Daily Range 4°
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RECORD OF THE WEATHER IN ST. LOUIS FOR OCTOBER, 1908

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau

Upper line indicates temperature in degrees Fahr.
Broken line indicates relative humidity in percentage from readings taken at 8 a. m. and 8 p. m.
Lower line indicates velocity of wind in miles per hour.
Arrows fly with prevailing direction of wind.
S—Clear. PC—Partly Cloudy. C—Cloudy. R—Rain.

5°, on the 31st. Mean temperature for the month, 57°, 2° above the mean of this month for 38 years. Total rainfall, 0.95 in., over 1½ in. less than usual. Prevailing direction of wind, northeast; total movement, 5,502 miles; average hourly velocity, 7.4 miles; maximum velocity (for five minutes), 32 miles per hour from the northwest on the 30th. There were 15 clear days, 6 partly cloudy and 10 cloudy. Rain fell on 7 days.

CHICAGO

Highest temperature, 82°, on the 21st; lowest, 34°, on the 31st. Greatest daily range, 27°, on the 13th; least daily range, 4°, on the 25th. Mean temperature for the month, 55°, 2° above the mean of this month for 38 years. Total rainfall, 0.81 in., over 1½ in. less than usual. Prevailing direction of the wind, southwest; total movement, 10,670 miles; average hourly velocity, 14 miles; maximum velocity (for five minutes), 36 miles per hour from the southwest on the 16th. 14 days were clear, 10 partly cloudy and 7 cloudy. Rain fell on 6 days.

BOSTON

Highest temperature, 80°, on the 18th; lowest, 35°, on the 31st. Greatest daily range, 28°, on the 14th; least daily range, 4°, on the 29th. Mean temperature for the month, 55°, 2° above the mean of this month for 38 years. Total rainfall, 3.70 in., very nearly normal. Prevailing direction of wind, northwest; total movement, 6,719 miles; average hourly velocity, 9 miles; maximum velocity (for five minutes), 35 miles per hour from the north on the 30th. 15 days were clear, 6 partly cloudy and 10 cloudy. Rain fell on 7 days.

ST. LOUIS

Highest temperature, 84°, on the 14th; lowest, 35°, on the 31st. Greatest daily range, 32°, on the 13th; least daily range, 4°, on the 26th. Mean temperature for the month, 58°, 1° below normal for this month for 36 years. Total rainfall, 0.21 in., over 2 in. less than usual. Prevailing direction of wind, south; total movement, 6,795 miles; average hourly velocity, 9.1 miles; maximum velocity (for five minutes), 34 miles per hour from the southwest on the 24th. 15 days were clear, 9 partly cloudy, 7 cloudy. Rain fell on 3 days.

Preventing Noise in Fan Systems

It is not, perhaps, generally known that most of the noise caused by a blower in a mechanical ventilating system originates at the foundation on which the fan rests. An ingenious method of overcoming this difficulty is mentioned by Mr. H. W. Whitten, of the Chamberlin Metal Weather Strip Co., Detroit, Mich. The remedy he cites is to separate the fan foundation from any other part of the building by a trench filled with sand and planked over. This method, he declares, will not only take up the vibration of the motor but will obviate the use of a flexible connection between the fan and the duct.

Current Heating and Ventilating Literature

Under this heading is published each month an index of the important articles on the subject of heating and ventilation that appear in the columns of our contemporaries. Copies of any of the journals containing the articles mentioned may be obtained from THE HEATING AND VENTILATING MAGAZINE *on receipt of the stated price.*

MINE VENTILATION

An Improved System for Ventilation of Mines. W. E. Elliot and J. G. Wilson. 1500 w. Min Wld—Sept. 5, 1908. 20 cents.

STEAM PIPES

Hangers and Supports for Piping Systems. William S. Fischer. 600 w. Power—Sept. 22, 1908. 20 cents.

The Piping Systems of High Pressure Plants. Charles L. Hubbard. Directions for arranging steam and water piping. Ills. 3500 w. Power—Sept. 22, 1908. 20 cents.

VENTILATION

The Requirements of Good Ventilation. Walter B. Snow. A statement of the principal facts and laws governing ventilation, giving practical applications, particularly with reference to the combined system of forced circulation and indirect steam heating. 3000 w. Dom Engng—Sept. 19, 1908. 20 cents.

Ventilation of the First Church of Christ, Scientist, Boston. Charles L. Hubbard. 2000 w. Eng Rec—Sept. 19, 1908. 20 cents.

SHOP HEATING

Heating and Ventilating a Sheet Metal Shop. Illustrated description of a fan system delivering air near floor level. 1300 w. Metal Work—Sept. 12, 1908. 20 cents.

Heating the McKees Rocks Shops, Pittsburgh & Lake Erie R. R. Douglas P. Morrison. Describes the system of heating 8 shops. 1200 w. Eng Rec—Sept. 5, 1908. 20 cents.

SHOP VENTILATION

Industrial Dust and Disease. Reviews a discussion at the Sheffield meeting of the British Medical Assn. 1200 w. Engr. Lond—Sept. 4. 1908. 40 cents.

HEATING SHOPS AND STATIONS

Heating of Electric Railway Buildings. Martin Schreiber. El Tr Wkly—Oct. 3, '08. 5 figs. 3300 w. 20 cents.

Heating the McKees Rocks Shops, Pittsburg & Lake Erie R. R. D. P. Morrison. Eng Rec—Sept. 5, '08. 1 fig. 1700 w. 20 cents. Describes the live and exhaust steam heating of shops covering 20 acres.

HYGROMETRY

Hygrometry in Its Practical Aspect. J. H. Hart. Power—Oct. 6, '08. 2800 w. 20 cents.

HEATING AND VENTILATING SHIPS

The Heating and Ventilating of Ships. Sydney F. Walker. Int Mar Engg—Oct., '08. 4 figs. 4200 w. 40 cents. Describes styles and sizes of fans used in ventilating, power required, etc.

CORROSION OF IRON AND STEEL PIPE

Relative Corrosion of Steel and Wrought Iron Tubing. Henry M. Howe and Bradley Stoughton. Eng & Min Jl—Sept. 19, '08. 2100 w. 20 cents. From a report to appear in full in the published proceedings of the American Society of Testing Materials.

Underground Insulation of Steam and Hot Water Pipes

By Harry Gillett

In recent years the matter of the insulation of pipes laid under ground has received wide attention on the part of engineers, and, as a result, forms of insulation have been devised to meet satisfactorily almost every requirement. Some of these methods are described in a paper by Harry Gillett, read before the Ohio Society of Mechanical, Electrical and Steam Engineers, at their meeting just held, Nov. 20 and 21, at Toledo, O. After drawing attention to the fact that nature presents some of the most interesting examples of insulation, he continues:

Why do we insulate underground steam and hot water pipes? In order that we may carry our steam or hot water the required distance with the least possible loss of heat or power. The insulation of such pipes can only be obtained by confining that pipe within a covering which contains dead, dry air split up into small particles by the use of some non-conducting, indestructible materials, felted or massed together.

Underground insulation of such pipes is difficult, for two reasons: First, on account of dampness getting into the covering (water being a good conductor of heat), which cannot be readily driven off, the pipes being confined by the earth; and, secondly, that the coverings themselves are liable to be attacked by destroying influences found in the earth itself. These, combined with the heat of the pipe inside and dampness on the outside of the covering, means certain death sooner or later to anything of an organic nature. Consequently, the future insulation of these pipes must of necessity be confined to methods and materials which will positively safeguard the pipes against such influences as above mentioned, and, so far as present knowledge permits, this seems to be either the tunnel or some form of conduit composed entirely of inorganic substances. We will consider these two types.

TUNNEL INSULATION

No one will dispute the statement that a tunnel is a pretty substantial proposition, and in a good many ways it has advantages which are worth consideration. The pipes are always accessible, and if a leak occurs there is not much trouble in locating it, so that repairs can be made without much difficulty. New pipes can be added from time to time as occasion requires, the tunnel being erected in a permanent manner and of size sufficient to accommodate additions. On the other hand, the first cost is very high, the excavation being relatively much larger than would ordinarily be required for the number of pipes contained. The pipes must be separately insulated, and as it is never thought necessary to cover the flanges under such conditions, the loss of heat from the pipes is sufficient at all times to comfortably heat a space, as a rule, approximating about the same number of cubic feet as are contained in one-quarter of the buildings which are to be heated. The argument is sometimes advanced that once this space is heated the loss is very slight, and to some extent this is true, but not by any means entirely so.

CONDUIT INSULATION

The other system is that using "vitrified sectional conduit." All the materials are absolutely inorganic, the shell being composed of a carefully selected and thoroughly ground and mixed combination of stoneware clay. After the material passes from the molds it is properly treated before being placed in the kiln, to avoid warping of the sections, this being extremely important. The conduit is scored in process of manufacture so that it can be readily split, which is done before shipping, each half being so marked that it can be identified on arrival, in order that the original tops and bottoms may come together. Before splitting, each conduit length must sustain a transverse test between hardwood supports which cover one-third of the entire circumference of the conduit.

The fitting or insulating material is composed of asbestos fiber and sponge, which is so intermixed that a maximum number of confined air-cells are obtained.

The pipes are carried on roll frames embedded in concrete, special tees being provided for this purpose, and whenever it is found necessary to anchor or turn a corner, brick pits are built. Almost any number of pipes may be placed in a single conduit, and it is purposed that no pipe shall have less than 3 in. of the insulating material around it. The pipes are perfectly insulated, and the entire conduit, with its contents, is self-contained. The loss in pressure is practically only that caused by the friction between the steam

or hot water and the interior surface of the pipes.

This conduit can be laid within 6 in. of the top of the ground, snow not melting directly over it, as long as the atmosphere is below freezing point, according to actual observation.

The question of installation is a vital one with this, as with all other mechanical devices, especially so as it is of the greatest importance that no leakage of water shall occur. The lower half sections and the roll frames must be in perfect alignment, and it is absolutely necessary that the pipes shall be tested with a cold-water test of at least 50 per cent. in excess of the steam pressure to be carried before the top half sections are placed or any insulating material put on; neither should caulking or rusting of joints be allowed. The job of steam fitting must be perfect, and experience teaches that by following this course it will remain perfect.

Observation tees are provided, in case it is necessary at any time to look for a leak, but after a long term of years, during which time many thousands of feet of the conduit have been placed under ground throughout the eastern states, it was proven that no observation is necessary, and the reason is simple. In the first place, the necessity for careful and proper installation has been duly recognized and taken care of; there is no chance of anything attacking the pipe from the outside, and with this danger eliminated the chances for necessity of renewal are very slight. In case, however, it does become necessary, after a long term of years, the defective pipe is easily located and the trouble and expense of renewal quite small.

On the other hand, the results to be obtained are almost marvelous. We have one case in mind, at Andover, Mass., where a line 600 ft. long was tested and the gauge at both ends showed exactly the same pressure, and other cases could be mentioned where approximately the same results have been obtained; in fact, no case was ever reported where, with proper installation, the efficiency test showed less than 90 per cent.

Various substances have been tried out, but most of them deteriorate so easily, so that, financially, nothing was found to equal, as an efficient insulating material, water and heat proof substances which could be molded into convenient shapes and be made to entrap a lot of air, for still and stagnant air is the very best kind of an insulator.

After many laboratory tests have been made on a large variety of substances, asbestos was found to fill the requirement best. It can be worked up easily into any shape, dense or loose in construction, and is not easily damaged by vibration of pipes, etc.

An idea as to the amount of energy lost due to condensation of steam in pipes may be derived from the statement that 6 ft. of 6-in. pipe uncovered will cause a loss of energy each hour equivalent to that generated by 1 lb. of coal under average conditions. A good covering reduces this loss at least 80 per cent.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

ANNUAL MEETING, JANUARY 19-21, 1909

In a letter announcing the date of the society's annual meeting, January 19-21, 1909, in the Engineering Societies building, 29 West Thirty-ninth street, New York, Secretary W. M. Mackay, 113 Beekman street, New York, says: "Papers and topics for discussion to be presented at this meeting should be in the hands of the secretary early in December. If you will prepare a paper, kindly advise the secretary of the title of it, so as to assist in arranging the programme. If you have any engineering topics for discussion, kindly send them to the secretary at once."

HEATING VALUES OF RADIATOR SURFACES

A special letter has been sent out by the Committee on Standards, asking for suggestions along its line of work, in order to make the report it will present at the annual meeting as full as possible. The following specific question is presented, with a request for an early reply:

"What rule do you use to ascertain the relative heating values of heating surface of different types of radiators, such as the standard tube types, the plain cast-iron section types, the extended surface types, such as the Gold Pin radiator, etc.; also, what rule have you to determine the ratios to use in direct-indirect, indirect, and forced draft systems?"

The chairman of the committee is Prof. William Kent, 601 Comstock avenue, Syracuse, N. Y.

COMMITTEE ON TESTS

In a letter addressed to the members of the society the Committee on Tests says: "Most of the members, during the year, come in contact with some material that would be very appropriately compiled by this committee, if it were only known. May we urge in behalf of the society that each member forward to the chairman or to any member of the committee any data thus obtained?" The chairman of the committee is Prof. James D. Hoffman, Lafayette, Ind.

NEW SOCIETY DIRECTORY

A new directory of the society has been issued, containing the names of 332 members. This is an increase of 58 names

since the previous issue. Included in the new directory are the lists of officers and committees for each year since the society was organized, and also the titles of all papers read before the society, arranged by years. There is also included the society's constitution and by-laws, together with organization of the Illinois Chapter.

Arrangements are being made to have Volume I of the society's proceedings reprinted, this being the only volume which is out of stock.

NATIONAL ASSOCIATION OF MASTER STEAM AND HOT WATER FITTERS

Fourth Annual Banquet of Newark (N. J.) Local Association

Notices have been issued of the fourth annual banquet of the Newark (N. J.) Local Association of Master Steam and Hot Water Fitters, to be held December 9, 1908, at Davis' Restaurant, 943 Broad street, Newark. Tickets are $3.50 each. Dinner will be served at 6 P. M. The entertainment committee is composed of Sol. Berla, John L. Earl and Robert Berla. The annual dinner of the Newark Association has come to be recognized as one of the most important social meetings of the year in the steam-fitting trade in New Jersey, and the forthcoming gathering, we are assured, will fully sustain this reputation.

American Society of Mechanical Engineers

The annual meeting of this society will be held in the Engineering Societies building, December 1-4, 1908. The programme includes the following papers:

The Engineer and the People, by Morris Llewellyn Cooke.

Liquid Tachometers, by Amasa Trowbridge.

A Method of Obtaining Ratios of Specific Heats of Vapors, by A. R. Dodge.

An Averaging Instrument for Polar Diagrams, by Prof. W. F. Durand.

The Slipping Point of Rolled Boiler Tube Joints, by Prof. O. P. Hood and Prof. G. L. Christensen.

Some Possibilities of the Gasolene Turbine, by Prof. Frank C. Wagner.

Salt Manufacture, by George B. Willcox.

Efficiency Tests of Milling Cutters and Milling Machines, by A. L. DeLeeuw.

Physical Properties of Carbonic Acid and Conditions of Its Economic Storage for Transportation, by Prof. R. T. Stewart.

The Total Heat of Saturated Steam, by Dr. H. N. Davis.

Industrial Photography, by S. Ashton Hand.

There will be in addition a paper on aeronautics by Major Squier, acting chief signal officer, Washington, D. C., together with a lecture on the same subject by Lieutenant Lahm. This is the first time that aeronautics has been considered by any of the national engineering societies of America.

Institution (British) of Heating and Ventilating Engineers

The autumn meeting of the Institution of Heating and Ventilating Engineers was held October 6 in the rooms of the Institution of Mechanical Engineers, London, England. The papers read were not made public. The following officers were elected for the ensuing year: President, Walter Yates, of Swinton; vice-presidents, C. I. Haden, J. D. Sutcliffe, J. G. Walker and C. F. Seward. The next meeting will be held February 16, 1909, in London.

Central Supply Association

At the annual meeting of the Central Supply Association, held October 28, 1908, at the Auditorium Hotel, Chicago, the following officers were elected for the ensuing year:

President, Samuel H. Moon, Ahrens & Ott Mfg. Co., Louisville, Ky.

First vice-president, William V. Ivy, N. O. Nelson Mfg. Co., St. Louis, Mo.

Second vice-president, George H. Gorton, W. B. Young Supply Co., Kansas City, Mo.

Treasurer, Edward F. Niedecken, Hoffman & Billings Mfg. Co., Milwaukee, Wis.

Secretary, Paul Blatchford, Tribune building, Chicago, Ill.

Executive Committee Samuel H. Moon, William Ivy, George H. Gorton, Edward F. Niedecken, James M. Young, Fort Pitt Supply Co., Pittsburg, Pa.; J. B. Rahm, United States Supply Co., Omaha, Neb.; P. J. Frey, Central Supply Co., Minneapolis, Minn.; John D. Hibbard, John Davis Co., Chicago.

National Committee of Confederated Supply Associations

The annual meeting of this organization was held in New York, October 15 last, when the following officers were elected for the ensuing year:

President, J. J. Ryan, J. J. Ryan & Co., Chicago.

Vice-president, W. A. Myler, Standard Sanitary Mfg. Co., Pittsburg, Pa.

Treasurer, L. O. Koven, L. O. Koven & Bro., New York.

Secretary, Frank S. Hanley, New York.

Board of Directors: J. J. Ryan, W. A. Myler, L. O. Koven, John D. Hibbard,

John Davis Co., Chicago; J. H. Borton, Haines, Jones & Cadbury Co., Philadelphia; J. S. Hoy, Hoy & Co., Troy, N. Y.

An Interesting Type of Warm Air Generator.

The discussion which led to the formation of the Federal Furnace League, whose object is the uplifting of the hot air furnace as a scientific heating medium, has brought into prominent notice a number of such heaters that are appealing to heating engineers as being built on correct theoretical principles.

Among these the Kelsey warm air generator has attracted much attention on account of the unique construction of its fire pot and dome. These are formed by a series of zig-zag heat tubes through which the warmed air passes, contributing both to a rapidity of flow and the uniform heating of the air.

The ability to secure large quantities of warm air through this form of construction has made the Kelsey warm air generator available for large heating installations as well as for smaller work, and, indeed, some of the most successful installations in which this heater is used is where large volumes of air are heated at high velocities. The heater is made by the Kelsey Heating Co., Syracuse, N. Y., and an interesting booklet on the features of the system is published for free distribution to those interested.

The Detachable Water Post a Feature of the Spence Boiler

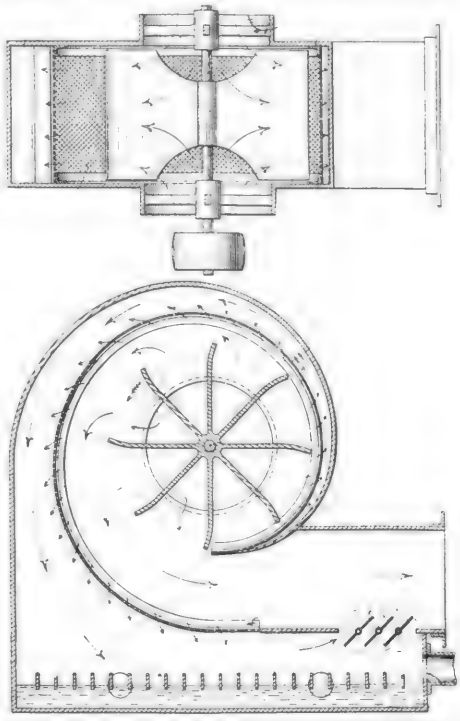
Pierce, Butler & Pierce Mfg. Co., Syracuse, N. Y., has issued a new Blue Book describing the "Spence" boiler. Particular attention is called to the detachable water post, which is an exclusive feature found only on the "Spence." All water connections are made with genuine "Rainbow" packing, stamped "Genuine Rainbow." The only water connection is this Rainbow connection between the water post and sections on the outside of the boiler, consequently erection is easy and there can be no leaky joints.

With the detachable water post, each section is an independent heater. It allows for using one section for heating water for domestic purposes, or in case of accident to any one of the sections it can be blanked at the water post and the boiler continued in operation.

The Blue Book describes the boiler in detail, giving measurement and list prices, and, we are advised, will be sent free to any one interested.

A Blower That Humidifies and Purifies Air

A new blower, patented by William J. Baldwin, of New York, is an ingenious device whose functions are not only to propel air and other gases, but also, at the same time, to separate the fine, suspended particles from such air and to supply it with any desired degree of humidity. In other words, this new blower



A BLOWER THAT PURIFIES AND HUMIDIFIES AIR. SHOWING SCREEN THROUGH WHICH SUSPENDED PARTICLES IN AIR ARE THROWN

is designed primarily to obviate the use of dust screens in heating and ventilating systems.

Mr. Baldwin's invention is the reverse of the usual method, in that it affects the separation of the suspended particles by blowing them at a high velocity, with a part of the air or gas, through a screen which is in the immediate vicinity of the blower where the velocity of air is highest. The air or gas which remains inside the screen, being freed from the suspended particles, flows away to the place of use, while the air or gas which passes through the screen with the suspended particles may be caused to flow over or past suitable devices, such as a body of water, which catch the particles.

In a number of tests of an apparatus built according to this design, Mr. Baldwin has obtained as much as 90 per cent. elimination of dust. A remarkable illustration of the quick action of the blower is seen when a shovelful of ashes is thrown into it while the fan is revolving at a high velocity. The dust and heavier particles are thrown violently against the screen and at the outlet the air contains only a trace of the ashes.

TRADE AND MISCELLANEOUS NOTES

Coming Events

December 1-4, 1908. Annual meeting of the American Society of Mechanical Engineers.

January 19-21, 1909. Annual meeting of the American Society of Heating and Ventilating Engineers.

Miscellaneous Notes

Little Rock, Ark.—Bankruptcy proceedings will not touch the Central Heating Company, the half million dollar corporation which supplies hot water heat for Little Rock, and which is now in the hands of H. M. Armistead as receiver, according to the attorneys for the heating company. Soon after the company passed into the hands of a receiver it was reported to the attorneys who had the matter in hand—a friendly litigation to reorganize the company and settle all of its affairs so far—that lesser creditors were preparing involuntary bankruptcy proceedings.

To forestall this the original creditors applied for the forcing of the corporation into involuntary bankruptcy. Judge J. B. Blackwood, attorney for the corporation, then brought up the question that such procedure could not stand in court for lack of jurisdiction, the hot water plant not being a manufacturer of anything; it did not deal in merchandise or publish books, periodicals or a paper, hence it was without the pale of the court. Judge Trieber held with the contention of the company's attorney, ruling that the heating of water and distributing it about the city was not a manufacturing business. This will leave the corporation undisturbed in the Chancery Court for an early adjustment of its affairs.

In reply to inquiries Receiver H. M. Armistead has issued a notice stating that the plant will be operated as usual this winter, regardless of the present receivership and insolvency proceedings.

Terre Haute, Ind.—The city of Terre Haute is suing the Terre Haute, Indianapolis & Eastern Traction Co., one of the charges being that the traction company is operating a commercial heating plant

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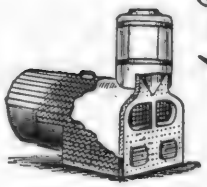

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without a license. Judge Piety, of the Vigo Circuit Court, who was hearing the case, when he learned of this feature of the complaint informed the attorney that he owns property which is heated by steam furnished by the traction company. As he was, therefore, an interested party in the case, he instructed counsel on both sides to agree on a special judge to sit in the case.

New York City's Public Service Commission has notified the street-car companies of New York that they must provide better heating and ventilation for the street cars of the city.

Bureau of American Manufacturers in Europe has been organized in London, England, where a permanent exhibit of American products will be established.

Two-cent rate of postage to England has already increased the volume of first-class foreign mail 100 per cent., according to Postmaster Morgan, of New York. The new rate went into effect October 1, 1908.

Bath, N. Y.—A plan is on foot to establish a central station steam heating plant in Bath in connection with the electric lighting plant being installed by the Citizens' Electric Service Co.

San Francisco, Cal., reports building operations for September to be the largest of any month this year. The figures are $3,799,543, which are 50 per cent. above those of August.

Rockford, Ill.—An ordinance has passed the city council permitting the Rockford Electric Company to extend its heating system. The east side of the river is likely to be supplied with the heating service next year, as the company has plans for getting its pipes across the river.

A. A. Griffing Iron Co., Jersey City, N. J., through the receiver, Frank P. McDermott, has paid its creditors 70 cents on the dollar. Mrs. Fannie Williams, widow of Thomas Williams, one of the principal stockholders of the company, agreed to accept $107,000 in lieu of her claim of $200,000.

Charles K. Foster, manager of sales, and W. H. Hill, manager of the manufacturing department, of the American Radiator Company, left for Europe October 16 in connection with the business of the company.

New Incorporations

Hermann H. Russ & Sons, Albany, N. Y., capital $8,000, to conduct a heating, plumbing and roofing business. Incorporators: Hermann H. Russ, Jr., John P. Russ and Effie Russ.

Krekel Bros. Co., White Plains, N. Y., capital $25,000, to manufacture boilers and heaters for steam and hot water heating systems. Incorporators: J. L. Krekel, H. W. Krekel and H. Berje.

Warren City Tank & Boiler Co., Warren, O., has incorporated with a capital stock of $150,000. Incorporators: Alfred R. Hughes, Daniel J. O'Rourke, John D. Edwards, Benjamin W. Edwards and Bert H. Seiple.

Akron Heater Co., Akron, O., capital $5,000, to manufacture heaters, radiators and stoves. Incorporators: W. C. Scott, George E. Cady and Henry L. Avery.

Lambert-Springer Co., Manila, Philippine Islands, has been organized to conduct a wholesale hardware and plumbing business at that point. The company's address is 83 Calle David. Leon J. Lambert and Milton E. Springer are the principals.

Roekel Plumbing & Electrical Co., Zanesville, O., capital $10,000, to conduct a general plumbing and electrical contracting business. Incorporators: Henry Roekel, James V. Clark, Charles A. Rosa, Leland R. Adams and George Schusler, all of Zanesville.

Oakland Plumbing Co., Pittsburg, Pa., capital $5,000, to take over the business conducted under the same name. Incorporators: Mary McDonald, William T. McDonald, John J. Kerrigan and L. A. Kerrigan, all of Pittsburg.

Magnesia Company of New England, Boston, Mass., capital $2,200,000, to manufacture asbestos and magnesia steam pipe and boiler covering and other magnesia products. The company will occupy the plant of the Putnam Mail Company, at Neponset, Mass. An allied company, the Magnesia Company of America, is building a plant at Newark, N. J. The officers of the new concern are: Vice-president, James D. Rommus; secretary, Mr. Hopewell; treasurer, John A. Qualey; general manager, James W. Reid.

Smokeless Heat & Power Co., Cleveland, O. Capital stock, $500,000. The process to be used has been tried out in a

"THE POTTER" MESH SEPARATOR
OR BOILER DRY-PIPE
DRY STEAM—SAFETY—ECONOMY
POTTER SEPARATOR CO., Newburgh, N.Y. N.Y. OFFICE: 39 Cortlandt St.

THE KELSEY WARM AIR GENERATOR

The Kelsey is constructed on the principle of warming large volumes of air by bringing into direct contact with extensive surfaces **which have been properly heated.**

This is accomplished by passing the air in separate currents through cast iron flues known as ZIG-ZAG Heat Tubes.

These Heat Tubes are so arranged in each Generator that they surround the fire and form the **Fire Cylinder and Combustion Chamber.**

Each Heat Tube weighs about 70 lbs. and has eight square feet of heating surfaces, and there are from eight to sixteen tubes in each Generator, according to its size and capacity.

Surrounding the Heat Tubes, and four inches removed from their backs, is the "Inside Casing," and surrounding the Inside Casing, with three inches of space between, is the outer or Galvanized Iron Casing. The space between the backs of the heat tubes and the Inside Casing forms the draft chamber, and the "products of combustion" pass out of openings between the flues at the top of the combustion chamber, into the draft chamber and thence down around the "baffle-plate" and back again to the "indirect draft" opening.

The Heat Tubes give the Kelsey in the medium size Generator (No. 21 with 21 inch grate) an average of 61 square feet of heating surfaces to each square foot of grate surface, or more than double that of the ordinary furnace.

The air passing through the Zig-Zag Heat Tubes is thoroughly mixed and evenly warmed.

With any fire the Tubes must be heated, and the air passing through is warmed.

The Heat Tubes are heated by conduction, and, unlike the ordinary furnace, when the fire is banked for the night, warm air continues to flow into the rooms, and the house is warm in the morning if so required.

The great weight of the Heat Tubes means that they are not quickly subject to heat fluctuations, and with any ordinary attention to the fire an even, uniform temperature is easily maintained throughout the house.

The warm air currents are carried **to the top of the Generator,** and are **forced** out through the nearest heat conducting pipes.

Each Heat Tube is an independent heater in itself, and by capping over two or more of the tubes with the Kelsey Patented "Positive Cap Attachment," the warm air coming through these particular Tubes is forced through the heat conducting pipe to any room which may be exposed or distantly located.

The Zig-Zag Heat Tubes make the Kelsey the only heater that is properly designed to heat air travelling at a high velocity, as in the Mechanical System when forced by a fan or blower.

One No. 30 Kelsey Generator has by actual test, verified by uninterested parties, heated 4500 cubic feet of air per minute through 130° temperature with fan pressure. The efficiency test showed the high average of 85.7%.

The Kelsey method of warming air, the great heating surfaces of the Kelsey, the utilization of all the heat, and the capacity for warming large volumes of air properly and forcing to every part of a building, are the main reasons why the Kelsey Warm Air Generator has earned a reputation for efficient, economical and healthful heating.

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plant at Lima, and consists of a special device for converting crude or fuel oil into heat and power without smoke. Among the owners of the invention are J. W. Keenan and F. R. Hall, both of Cleveland.

John Curtin Plumbing & Heating Co., East Orange, N. J. Capital stock, $50,000. Incorporators: Harry H. Picking, David A. McBride and Leslie Gray.

Potter Heating Co., Denver, Col. Capital stock, $25,000. Incorporators: J. D. Potter, A. L. Melloy and W. A. Althouse.

Frank H. Ruddy Co., Baltimore, Md., capital $10,000, to conduct a heating and plumbing business.

Bolivar Foundry & Machine Co., Bolivar, Pa., founders, machinists, millwrights and heating engineers. J. S. Miller, secretary and treasurer.

P. J. Duff & Sons, New York, capital $10,000, to deal in heating specialties. Incorporators: Patrick, Joseph M. and Charles B. Duff, Elmhurst, L. I.

New Firms

Ralph P. Gold, Dicksonburg, Pa., has opened a heating and plumbing business in that place.

Ernest Pritts, Somerset, Pa., has engaged in the heating and plumbing contracting business at that place.

Beers Engineering & Equipment Co., Granite building, Rochester, N. Y., organized by Leroy F. Beers and Arthur Berman.

Newman Bros., New London, Conn., has been organized to take over the heating and plumbing business of Newman & Cronin, Mr. Cronin retiring. The new firm is composed of D. T. Newman, J. P. Newman and J. H. Newman.

Murray Bros., Ligonier, Westmoreland Co., Pa., have opened a heating, plumbing and gas fitting business at that place.

Greene Bros., 325 Broadway, Albert Lea, Minn., is a new heating and plumbing firm, composed of John P. and Charles E. Greene.

Peerless Heater Co., 7 Wood street, Pittsburg, Pa., has been organized to manufacture Peerless boilers and radiators. President, C. Howard Hook, recently president of the Reliance Heater & Supply Co.

Columbus Plumbing & Heating Co., Columbus, Wis., is a new firm, composed of C. A. Brady and H. C. Dunn.

Argo Plumbing & Heating Co., Summit, Ill., has opened a heating and plumbing contracting business at that place.

National Plumbing & Heating Supply Co., State street, Chicago, is a new supply house in the heating and plumbing trade. President, E. C. Garrity; secretary and treasurer, F. P. Garrity; vice-president, S. M. Murdock. E. C. Garrity was connected with Jas. B. Clow & Sons, and Mr. Murdock is known to the trade through his connection with the Nie Die and Machine Works.

Business Changes

Nelson S. Thompson has resigned his position as assistant chief mechanical and electrical engineer in the office of the Supervising Architect, Treasury Department, to accept a position with Jos. McWilliams & Co., Louisville, Ky., heating and ventilating engineers and contractors.

Enos Machine Co., Gallipolis, O., has added a heating and plumbing department to its business.

George & Runyon, 1919 Susquehanna avenue, Philadelphia, Pa., has taken over the heating and plumbing business conducted by J. S. Walters at 1919 Susquehanna avenue.

Armstrong Mfg. Co., Bridgeport, Conn., has moved its New York office to 248 Canal street, on account of the demolishing of the Centre street buildings to make way for the new subway at that point.

Standard Gauge Mfg. Co., Syracuse, N. Y., manufacturer of indicating and recording gauges, has moved its plant to Foxboro, Mass., where its new property occupies about 10 acres and includes two main buildings, each 60 ft. x 210 ft. and three stories high. The company was organized in 1899 with $25,000 capital. In 1904 the capital was increased to $150,000, and a further increase will be made to provide for the present enlargement of the business.

New Contracts

American Warming & Ventilating Co., Pittsburg, Pa., heating new $350,000 court house at Mercer for $11,300. J. W. Byers, of Pittsburg, has the plumbing contract at $4,410.

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As adapted to the various conditions covering the heating field they are ideal and unique, comprising all the advantages of older systems, without the disadvantages inherent to past methods, providing pure air for breathing, sectional radiation, power for domestic utilities and hitherto unknown reduction in fuel costs.
Engineers and Architects are invited to inform themselves as to their merits.
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Moline Heating & Construction Co., Moline, Ill., laying water mains and furnishing pipe at East Moline. The contract amounts to $20,000.

Scottdale Plumbing & Roofing Co., Scottdale, Pa., heating, plumbing and roofing of new Palmer plant of the H. C. Frick Coke Co., at Palmer, Pa. The contract provides for the heating and plumbing equipment of 50 houses for the miners.

E. W. Webster, DuBois, Pa., installing municipal water plant at Rimersburg, Pa. The work will engage 100 men for several months.

John W. Danforth Co., Buffalo, N. Y., heating contract for Naval Hospital building at Norfolk, Va. The contract amounts to $30,000, and includes piping, radiation, concrete conduits, waterproofing and pipe covering.

M. B. Sanders, Little Rock, Ark., heating and plumbing new Capitol Hotel at that place for $21,000.

Braden & O'Neil Plumbing & Heating Co., San Antonio, Tex., heating and plumbing new $175,000 Gibbs building.

William Hares' Sons, Wheeling, W. Va., heating and plumbing systems in $100,000 Y. M. C. A. building in that city.

Robert Dalzell, Jr., Co., San Francisco, Cal., heating and ventilating contract for the new Palace Hotel in that city. The contract amounts to $35,497.

F. S. Schardein & Sons, Louisville, Ky., steam heating State University buildings.

Hawkins Bros. Co., Painsville, O., heating, ventilating and plumbing of new Central High School at Painsville.

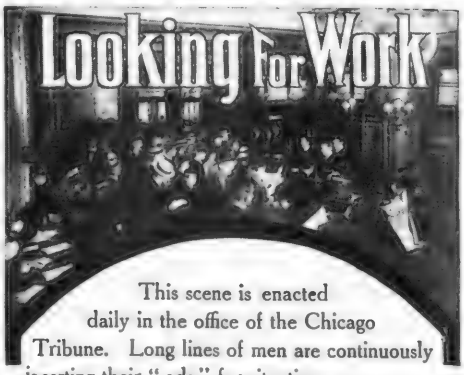
Herbert E. Havens, Philadelphia, Pa., contract for one-story power house, 32 ft. x 38 ft., on Oregon avenue, for the Girard Estate. The contract price is $20,000. The plant is intended to supply steam heat and electric light to the large number of dwellings to be built by the Girard Estate in the vicinity of Twentieth street and Oregon avenue.

Blumve & Jay, Los Angeles, Cal., converting present steam heating system at County Court House into a vacuum system, for $4,997. The Illinois automatic vacuum system will be used.

Business Chances

Jeffersonville, Ind.—Supt. Whittaker, of the Indiana Reformatory, has asked the board of trustees for an appropriation of $10,000 to install a new heating system in the institution.

Springfield, Mo.—A contract was to be let November 9 for the installation of a $20,000 central heating plant for Drury College. The change from the present system to the new method of heating will be made during the holidays. The plant



This scene is enacted daily in the office of the Chicago Tribune. Long lines of men are continuously inserting their "ads" for situations.

How easily any one in this crowd could put himself forever above such a quest for insignificant, poorly paid positions!

It is only positions that require special training, special skill, special knowledge that must and do seek the man. Hundreds of such positions are advertised day after day and still cannot be satisfactorily filled.

The American School of Correspondence, Chicago, is constantly fitting thousands of young men to start life in positions where there is an assured future for a man of ambition and brains. It is taking older men from poorly paid, uncongenial work and placing them where they can secure better pay, better future, better hours and better work for the rest of their working days.

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....MATHEMATICS
....MECHANICAL ENGINEERING
....MECHANICAL DRAWING
....STATIONARY ENGINEERING
....ARCHITECTURE
....HYDRAULICS
....COLLEGE PREP. COURSE

Name.....

Address.....

Occupation.....

will include a power house, 42 ft. x 52 ft., with a 70-ft. smokestack.

Five boilers will be used in generating the steam. The four boilers now in use in the heating plants in as many college buildings will be utilized, and in addition to this a new 70-horse power boiler. This will give a total of 200 horse power boiler capacity.

One large tunnel will be constructed under the campus to the rear of Pearson Hall. From that point conduits will take the steam to the president's residence, Fairbanks Hall, Pearson's Hall, Stone Chapel, Music Hall, the West Academy building, the Kappa Alpha house, the new gymnasium building and McCullagh Cottage.

Dallas, Tex.—New heating and plumbing systems will be installed in the city hall.

Omaha, Neb.—A general remodeling of the heating plants of city school buildings has been recommended by Chief Salter, who favors the removal of all heating plants from the buildings, especially steam plants.

Washington, D. C.—Sealed proposals will be received at the office of the Supervising Architect, Treasury Department, for the following named work:

Until November 27, 1908, for the construction complete of the U. S. Post Office at Milford, Del.

Until November 30, 1908, for the construction complete of the U. S. Post Office at Manchester, Va.

Until December 1, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Newton, Kan.

Until December 2, 1908, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) of the U. S. Post Office at Carlisle, Pa.

Until December 8, 1908, for the construction complete of the U. S. Post Office at Gainesville, Ga.

Wanted

A practical estimator and solicitor for steam and hot water heating concern. State age, salary desired, experience and references. Good opening. Address H, care THE HEATING AND VENTILATING MAGAZINE.

Books Received

Electric Furnaces, by Wilhelm Borchers. Translated by Henry G. Solomon, A.M.I.E.E. Pp. 224. Longmans, Green & Co., New York. Price, $2.50.

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R. J. Bingham — Formerly with Hotel Woodward

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The greatest factor in economical heating is an efficient pipe covering. When steam or hot water are delivered through uncovered or poorly insulated pipes, the loss by radiation and condensation, and the consequent waste of fuel, is enormous. Unfortunately, radiation and condensation cannot be observed, consequently many who realize the necessity of covering pipes, do not realize that many pipe coverings are but little better than none and are only deceiving.

ASBESTOCEL PIPE COVERING

is many times as efficient as ordinary pipe covering for hot water, and low and medium pressure steam, because it is made on a different principle.

The insulating properties of any pipe covering depend on the amount of dead (motionless) air it confines. ASBESTOCEL is built on the principle of an arch, with the air cells running around the pipe, preventing the circulation of air; while other coverings have the cells running from end to end, allowing the air to travel back and forth.

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(875a)

Trade Literature

Ideal Round Boilers for Steam and Water, Ideal Sectional Boilers for Steam and Water, and Ideal 48-In. Sectional Boilers, are the titles of three publications issued by the American Radiator Co., Chicago, Ill. Although technically catalogues, they really merit a higher designation, for both in text and illustration they are superb examples of the printer's art. Two of the covers contain reproductions of symbolical paintings, remarkable for their beauty, one being entitled "The Spirit of Steam" and the other "The Spirits of Water Welcoming Heat."

The publications contain detailed information, sizes, etc., regarding the company's well-known types of boilers, the round types described including the Ideal Arco as well as the Ideal Standard and Ideal Premier series. There is also much engineering information expressed in terse paragraphs at the foot of each page, some of the paragraphs being manifestly in reply to questions recently raised before engineering bodies. Some of these are as follows:

There are boilers offered whose rated capacity is based on the total heating surface, regardless of its position. Other boiler ratings are based entirely on grate surface. Either method is misleading, because the value of heating surface is governed by its position, and the value of grate surface is regulated by the frictional resistance in the gas passages or flues.

Good combustion is impossible without a hot smoke-pipe. In carrying a smoke-pipe temperature of 400 to 500° F. there is less loss than at 250° F. The reason is that with a low temperature insufficient air enters the fuel for thorough combustion—the fuel burns to carbon monoxide and the heat liberated is far below normal.

Some writer has said that a square foot of heating surface in a boiler has no greater power of heat transmission now than it had forty years ago. Very true, but the position of the heating surface may be so arranged as to quadruple the rate of transmission. The position is the dominant factor.

The direct heating surface which transmits 8,500 B. T. U. per hour will furnish heat for 35.4 sq. ft. of steam radiation per sq. ft. of heating surface. The flue surface nearest the smoke outlet which transmits 350 B. T. U. per hour will furnish heat for only 1.45 sq. ft. of steam radiation per sq. ft. of heating surface, a ratio in heat transmission of 24.3 to 1.

The catalogue descriptive of the 48-in. Ideal sectional boilers will be found of

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unusual interest as showing the availability of this type of heater in large installations. A comparison is made of the relative values of these boilers and the wrought-steel tubular boilers commonly used. Among the various advantages of the Ideal sectional boilers are mentioned: Easy erecting, no excavation, masonry or brick setting, low rate of combustion in mild weather, large vaporizing capacity, no tubes to corrode or rust, capacity easily changed, large area of direct heating surface, facilities for cleaning, no appreciable inside scale. A portion of the catalogue is devoted to erecting directions, which are illustrated with photographs of an Ideal sectional boiler in the various stages of erection. Each catalogue has 32 pages. Size, 8x10½ in. each.

Buffalo Fan System, Heating, Ventilating, Humidifying, Drying, Catalogue 197, has just been issued by the Buffalo Forge Co., Buffalo, N. Y., and will rank high as one of the most complete and useful treatises on this subject that has ever been issued for free distribution. It is a book of 144 pages, divided into four general sections. Part I is devoted to heating and ventilating of public buildings; Part II to heating and ventilation of industrial buildings; Part III to the Buffalo heating and ventilating apparatus; and Part IV to data on heating and ventilating. In addition to much new data, attention is especially called to the Carrier air washer and humidifier, the Buffalo gas heater for use where natural gas can be obtained, producer gas used or where manufactured gas is moderate in price; and the Buffalo air economizer, designed for utilizing the waste heat of boiler flue gases, etc. Fifteen layouts of Buffalo heating and ventilating systems as installed in typical buildings are included among the illustrations.

Under the heading of "Data on Heating and Ventilating" the subjects covered are: Relation of velocity to pressure, measurement of air flow, friction of piping, circular equivalents of rectangular ducts, data for determining sizes of main and branch pipes and flues, how to proportion piping in industrial buildings, friction of heaters, proportioning ducts for public buildings, heat losses in buildings, heater performance, properties of air, and also a number of heating tables with descriptive matter showing their application. Pp. 144. Size, 6x9 in. (standard).

Niagara Radiator and Boiler Co., No. Tonawanda, N. Y., has organized with the following officers: President and treasurer, Edwin C. Andrews; vice-president, John T. Andrews; secretary, H. C. Ballard; acting secretary, H. A. Smith; sales manager, W. S. Newkirk; plant manager, A. M. Everhart.

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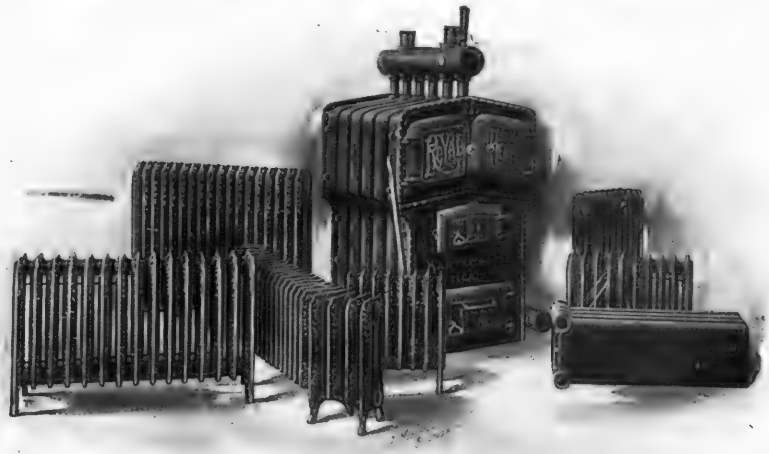

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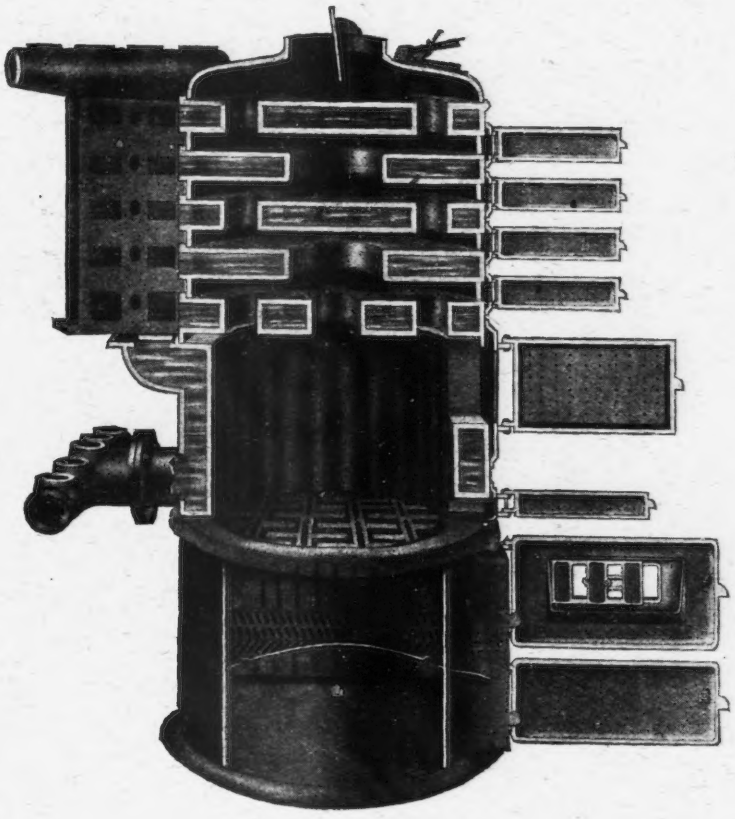

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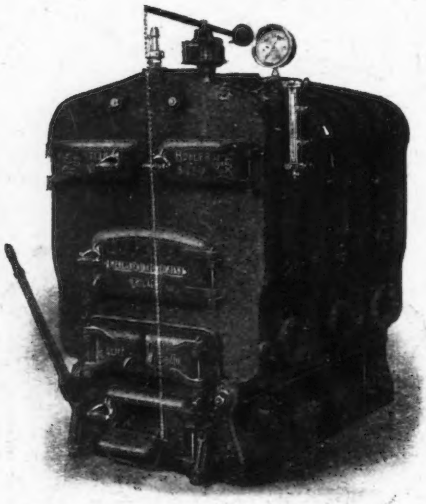

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